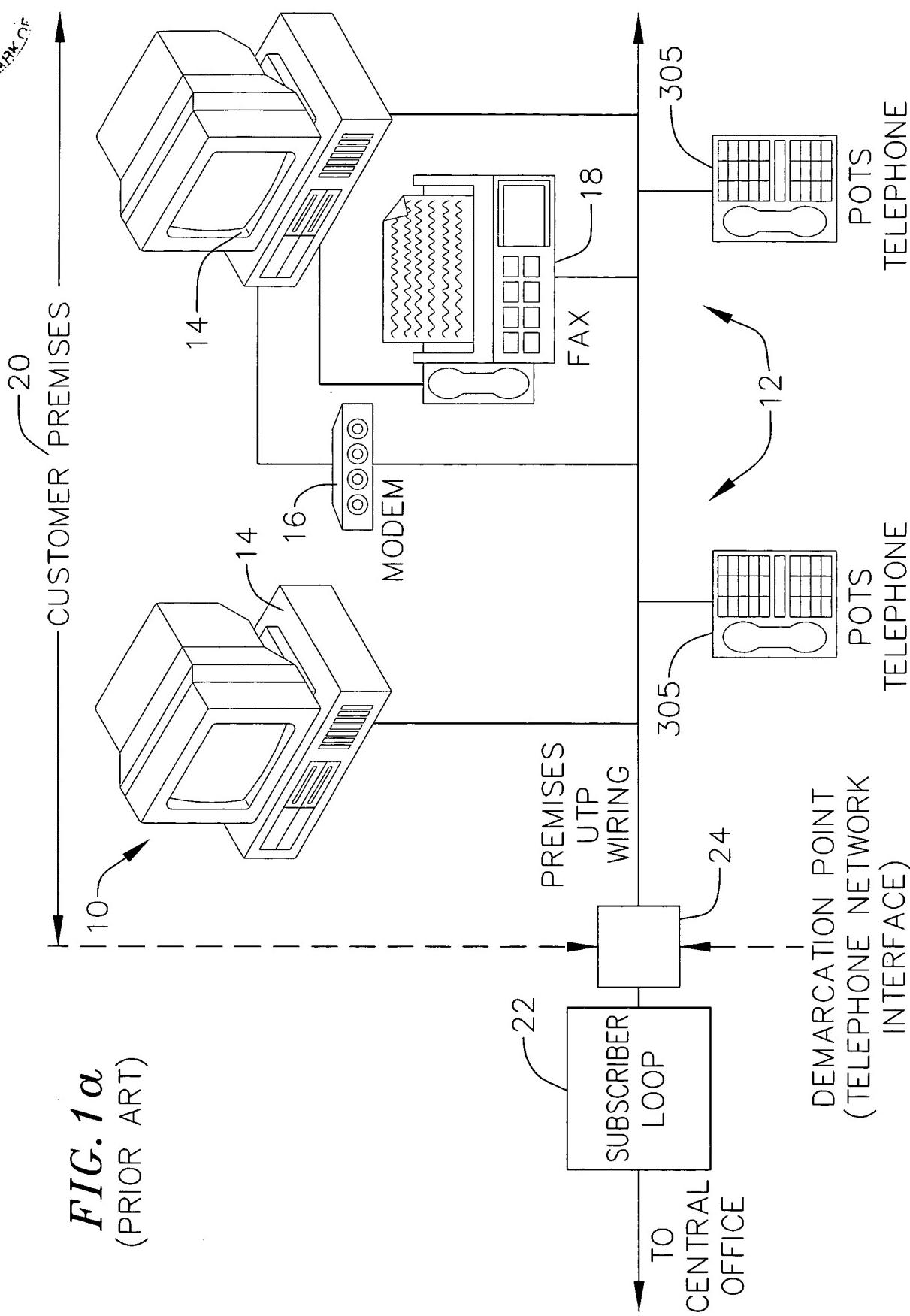


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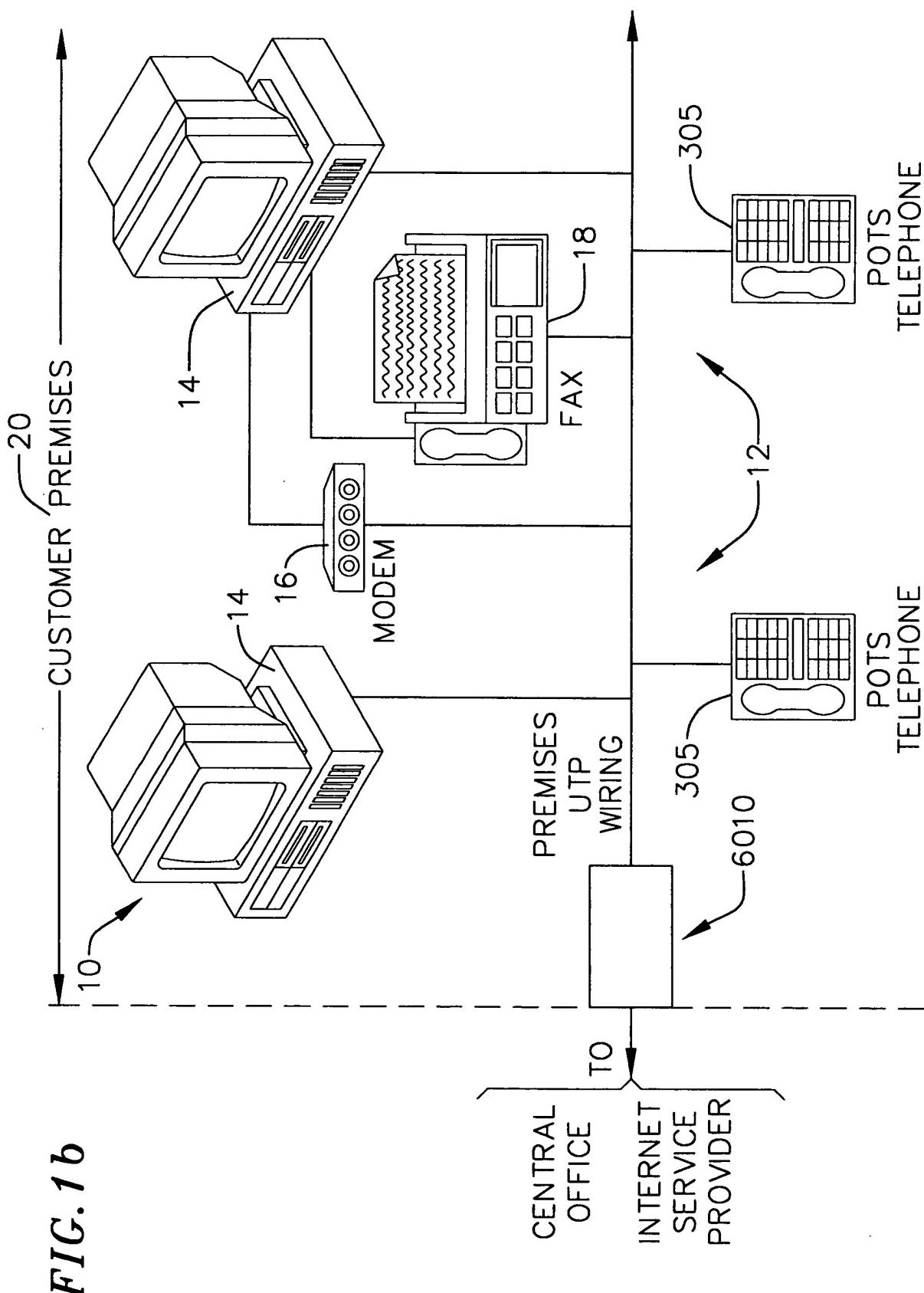
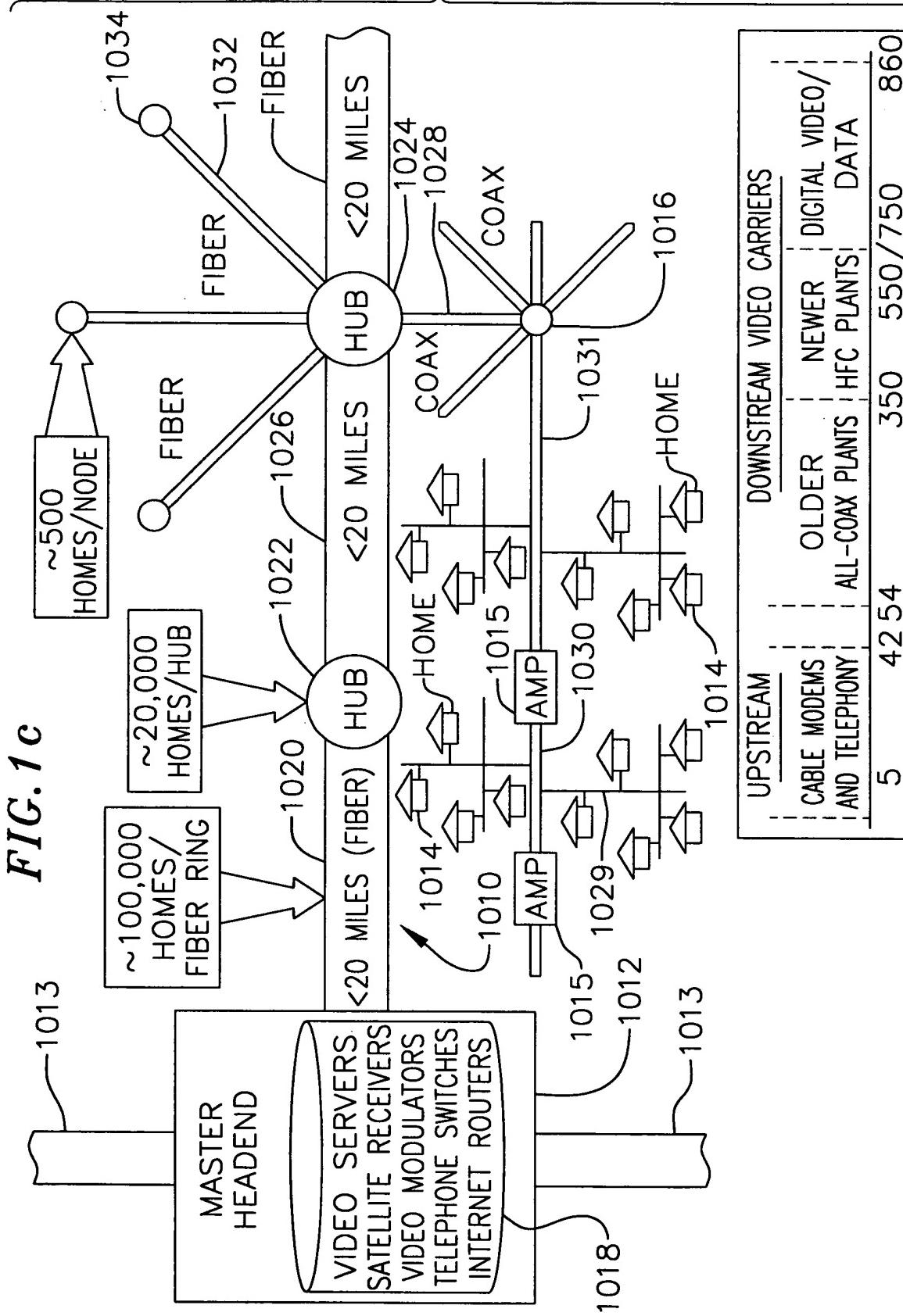


FIG. 1 C



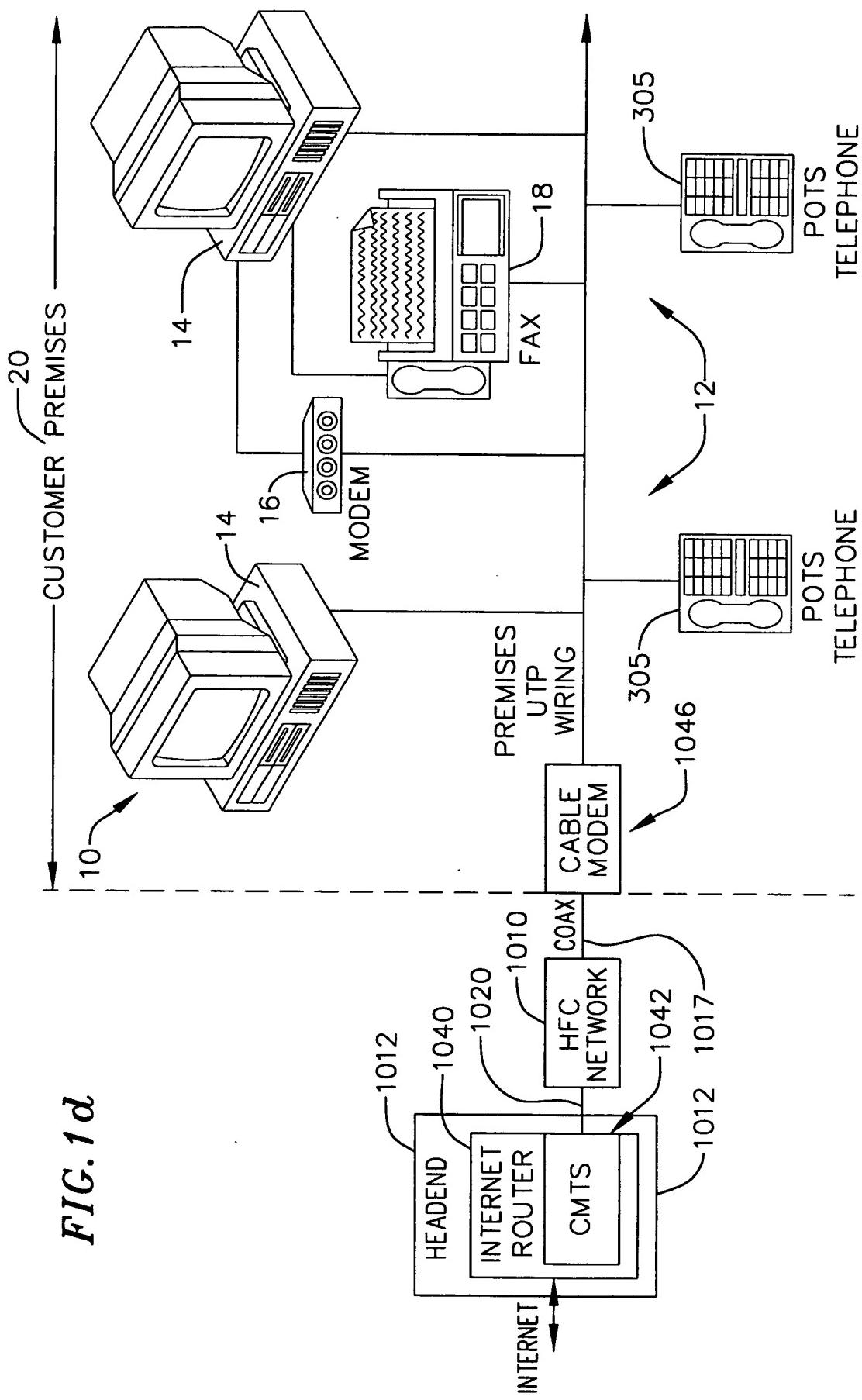


FIG. 2

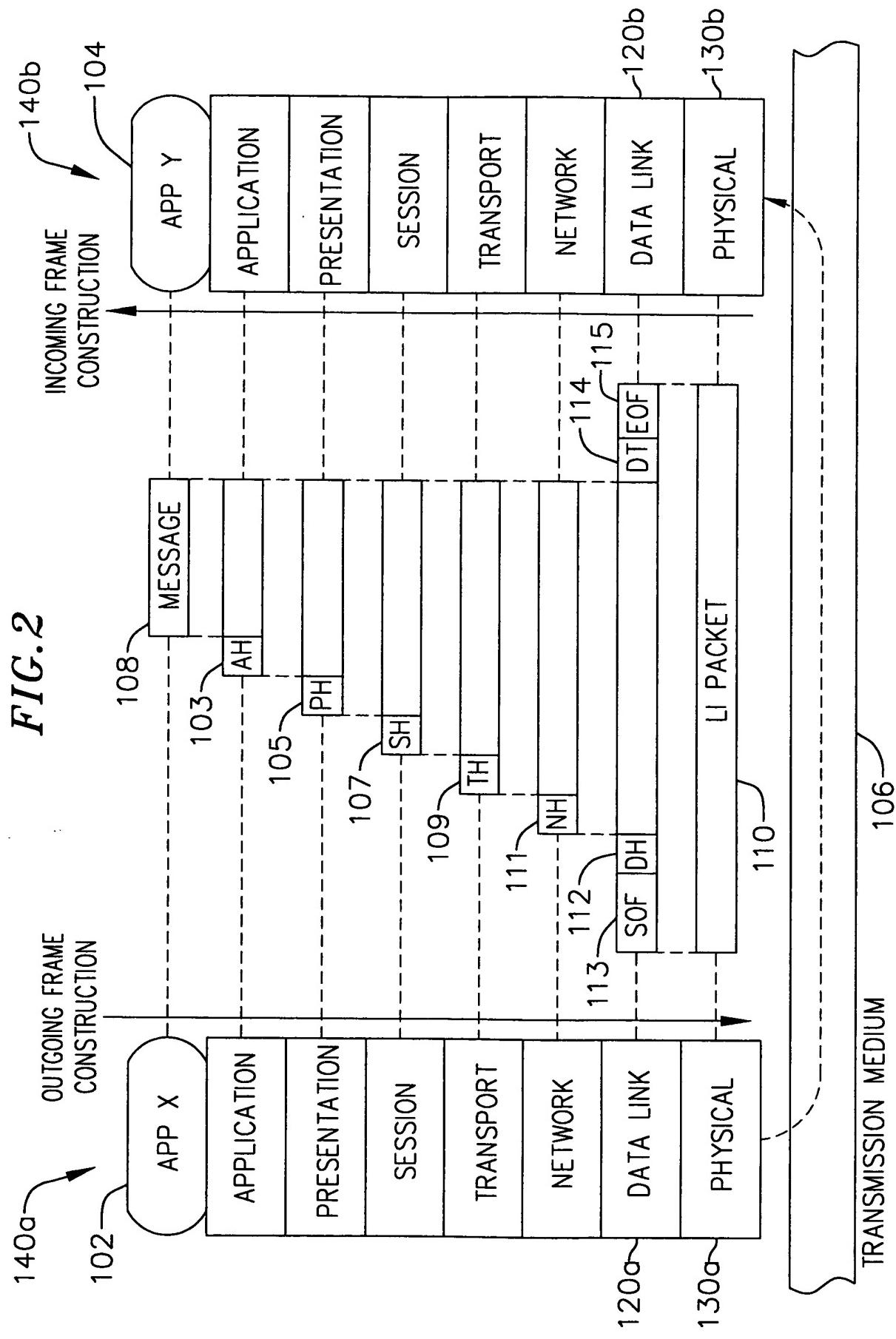


FIG.3a

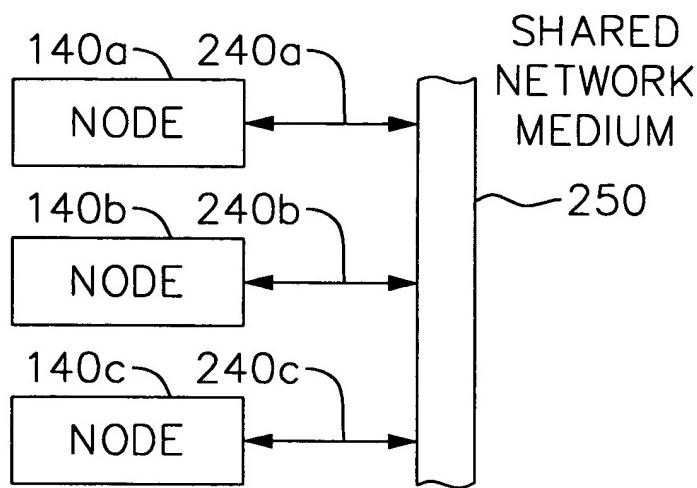


FIG.3b

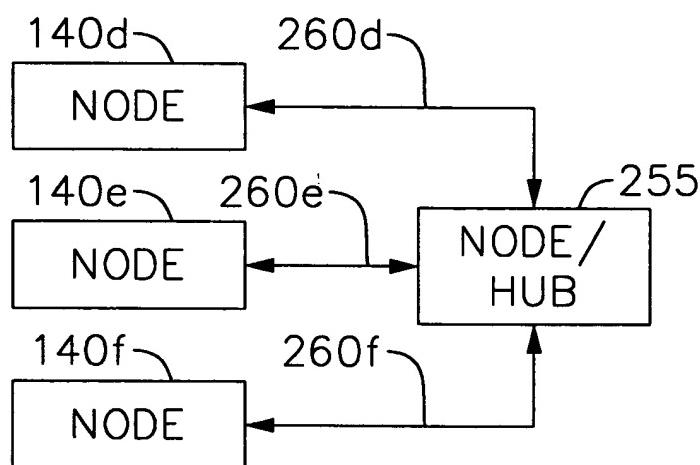


FIG. 4a

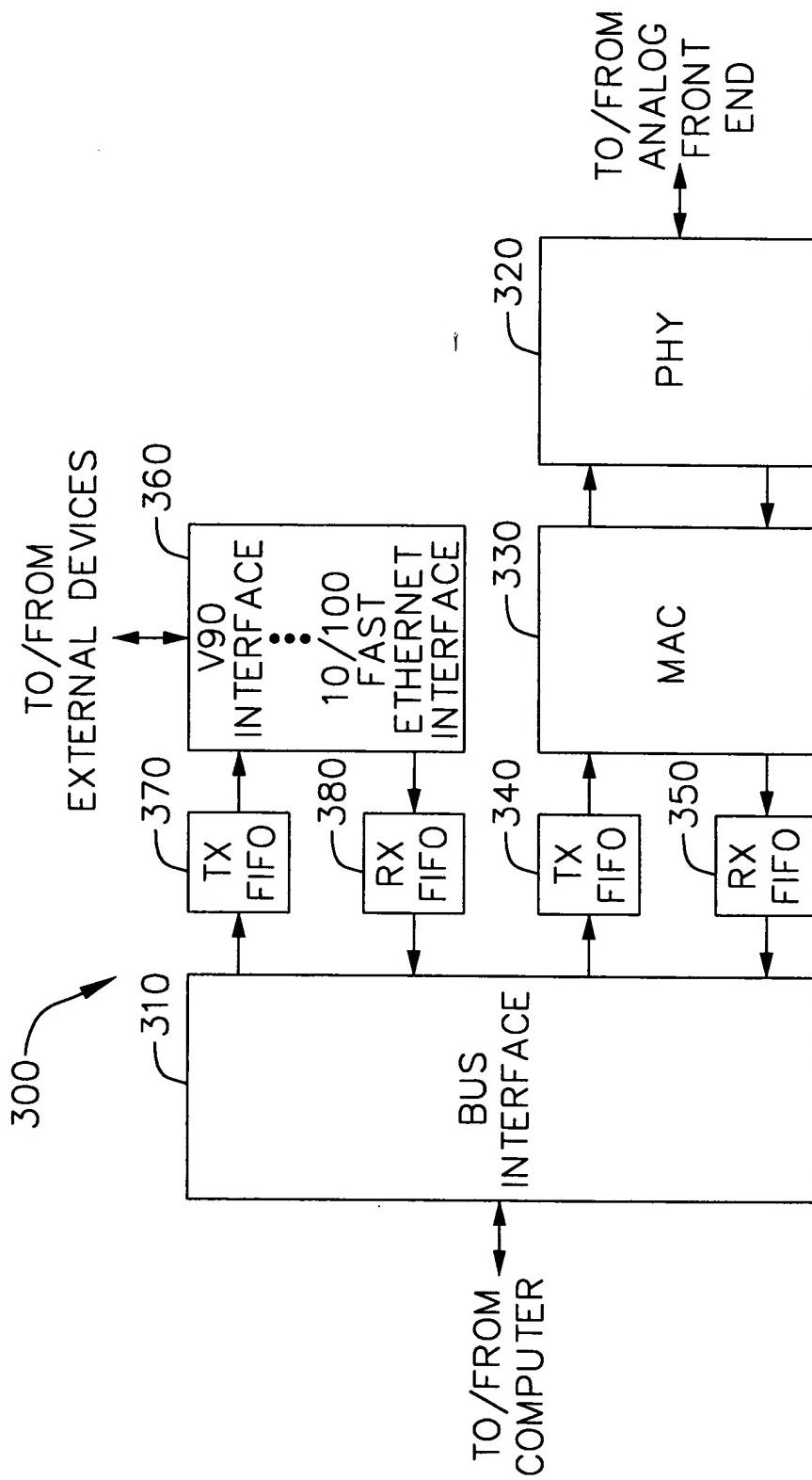
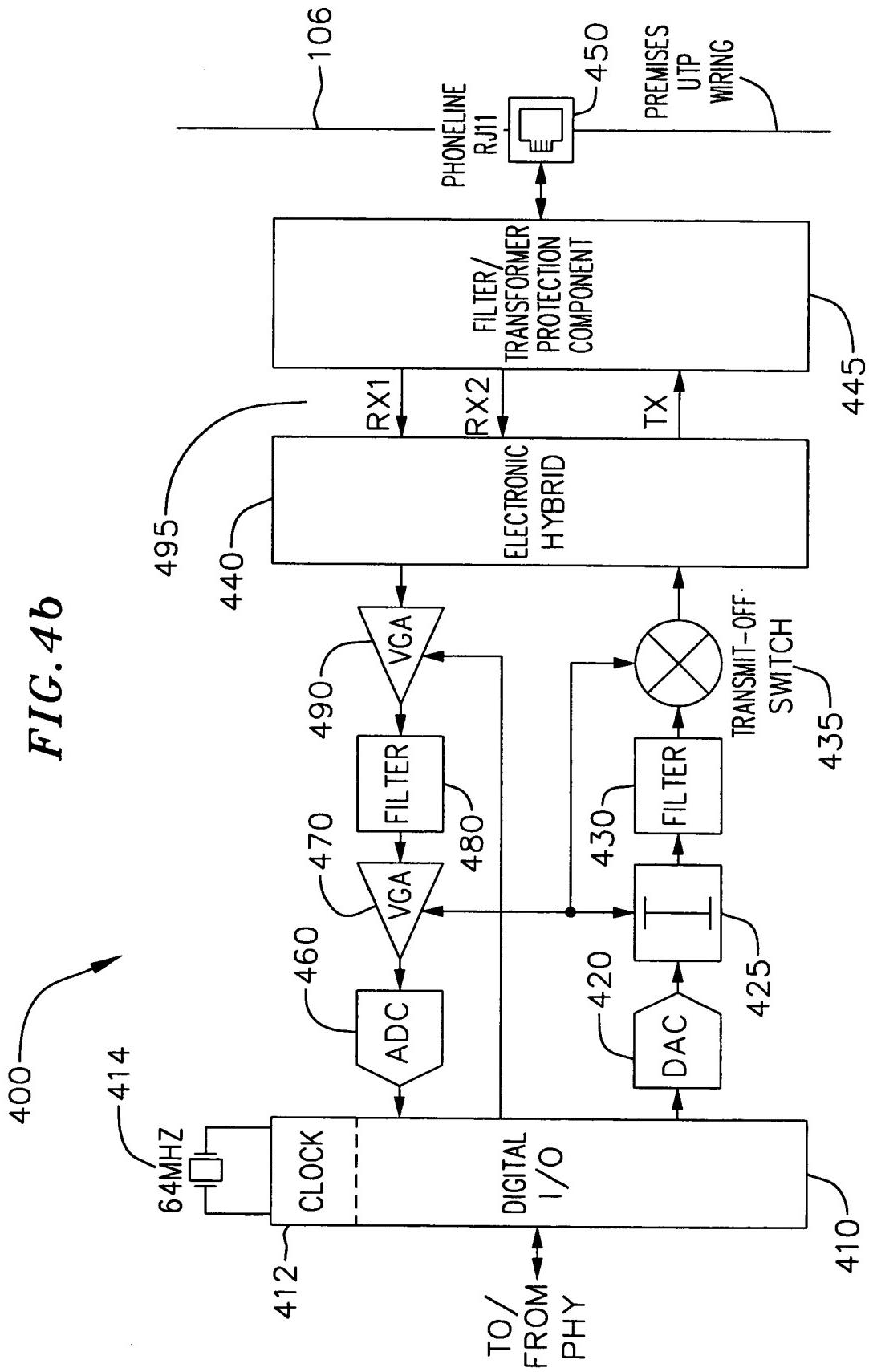


FIG. 4b



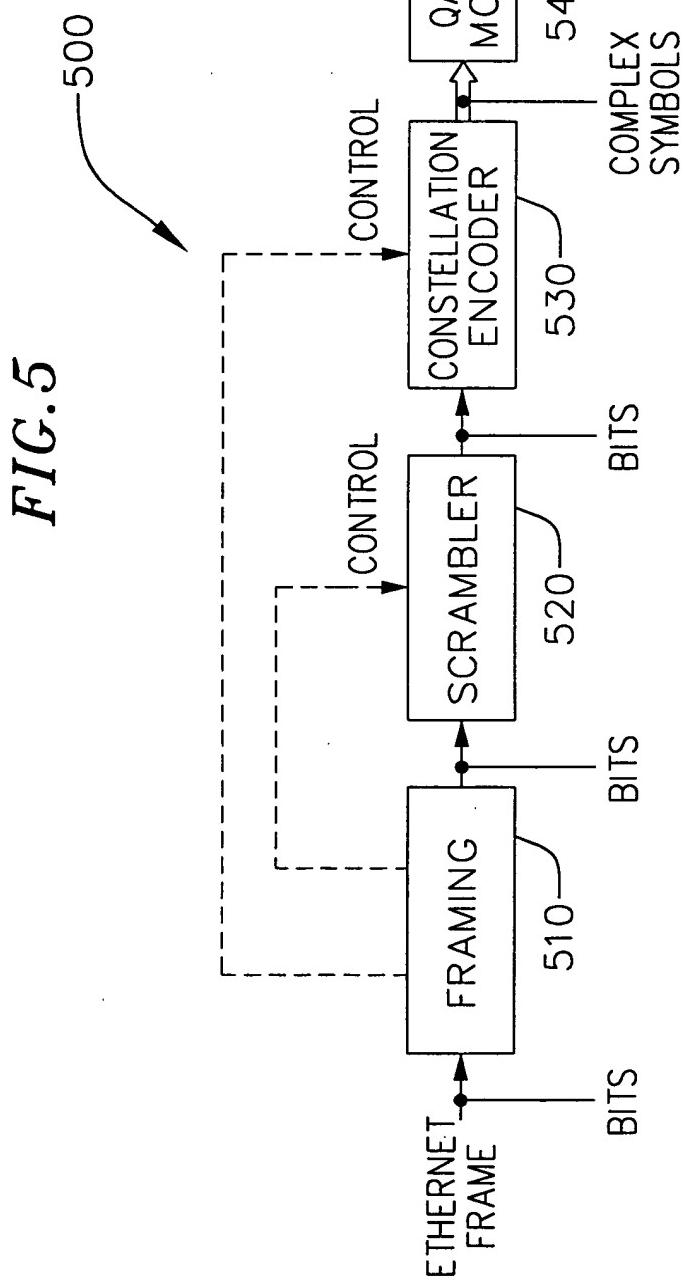


FIG. 6

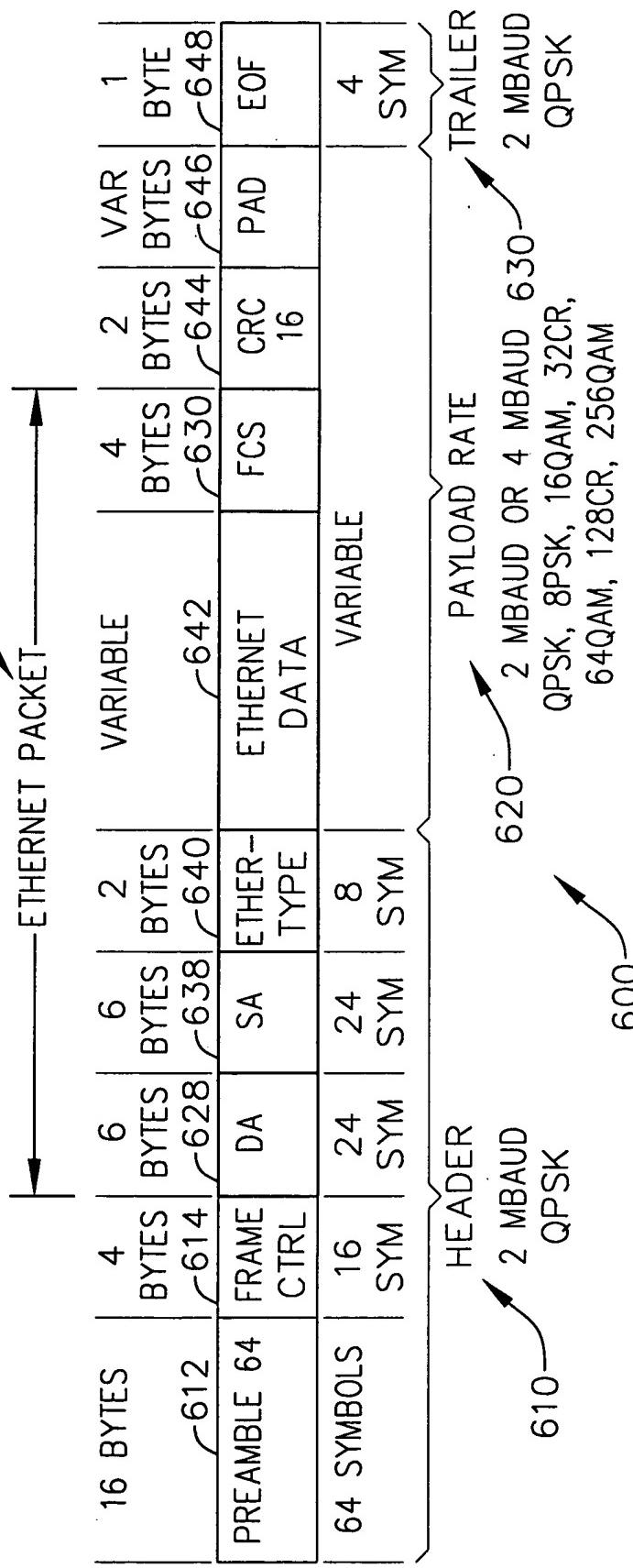


FIG. 8

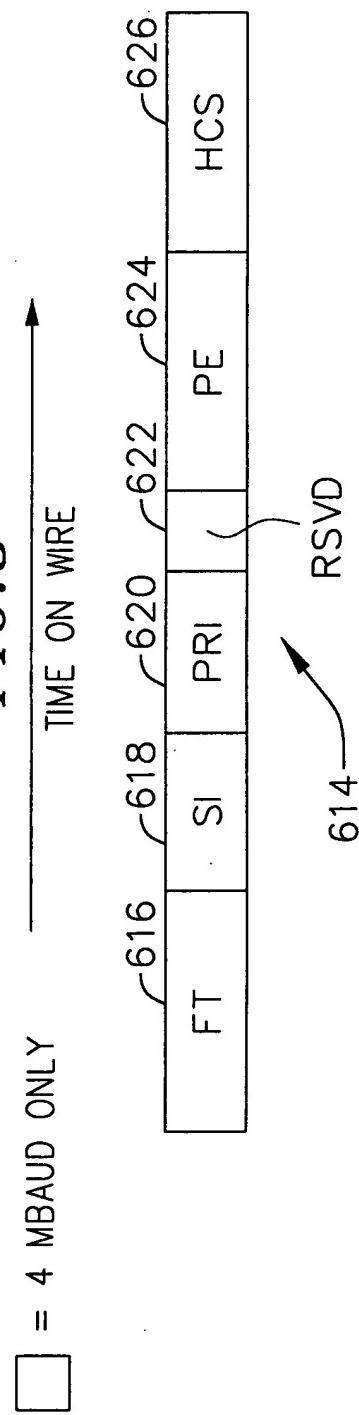


FIG. 7

| FIELD | BIT NUMBER | BITS | DESCRIPTION |
|-------|------------|------|--|
| FT | 31: 24 | 8 | FRAME TYPE. THIS FIELD SHALL BE SET TO ZERO BY THE TRANSMITTER. THE RECEIVER SHALL DECODE THIS FIELD AND DISCARD THE FRAME IF IT'S ANYTHING OTHER THAN ZERO. |
| RSVD | 23 | 1 | RESERVED. THIS FIELD SHALL BE SET TO ZERO BY THE TRANSMITTER, AND THE RECEIVER SHALL IGNORE IT. |
| PRI | 22: 20 | 3 | PRIORITY (0-7) |
| SI | 19: 16 | 4 | SCRAMBLER INITIALIZATION |
| PE | 15: 8 | 8 | PAYLOAD ENCODING |
| HCS | 7: 0 | 8 | HEADER CHECK SEQUENCE |

FIG. 9

| VALUE | INTERPRETATION |
|--------|--|
| 0 | RESERVED ON TRANSMIT, DISCARD FRAME ON RECEIVE |
| 1 | BAUD RATE=2 MHz, 2 BITS PER BAUD |
| 2 | BAUD RATE=2 MHz, 3 BITS PER BAUD |
| 3 | BAUD RATE=2 MHz, 4 BITS PER BAUD |
| 4 | BAUD RATE=2 MHz, 5 BITS PER BAUD |
| 5 | BAUD RATE=2 MHz, 6 BITS PER BAUD |
| 6 | BAUD RATE=2 MHz, 7 BITS PER BAUD |
| 7 | BAUD RATE=2 MHz, 8 BITS PER BAUD |
| 8 | RESERVED ON TRANSMIT, DISCARD FRAME ON RECEIVE |
| 9 | BAUD RATE=4 MHz, 2 BITS PER BAUD |
| 10 | BAUD RATE=4 MHz, 3 BITS PER BAUD |
| 11 | BAUD RATE=4 MHz, 4 BITS PER BAUD |
| 12 | BAUD RATE=4 MHz, 5 BITS PER BAUD |
| 13 | BAUD RATE=4 MHz, 6 BITS PER BAUD |
| 14 | BAUD RATE=4 MHz, 7 BITS PER BAUD |
| 15 | BAUD RATE=4 MHz, 8 BITS PER BAUD |
| 16-256 | RESERVED ON TRANSMIT, DISCARD FRAME ON RECEIVE |

FIG. 10

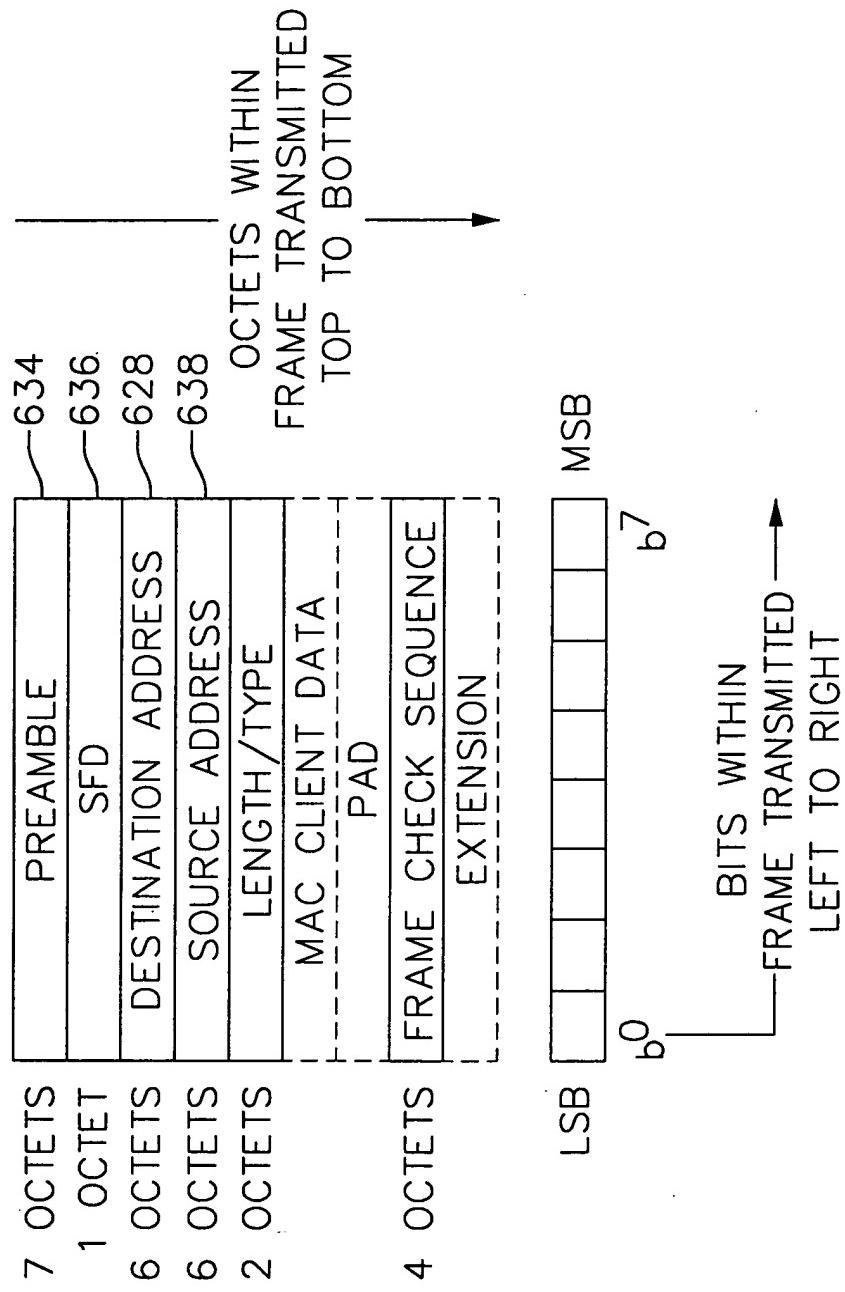


FIG. 11

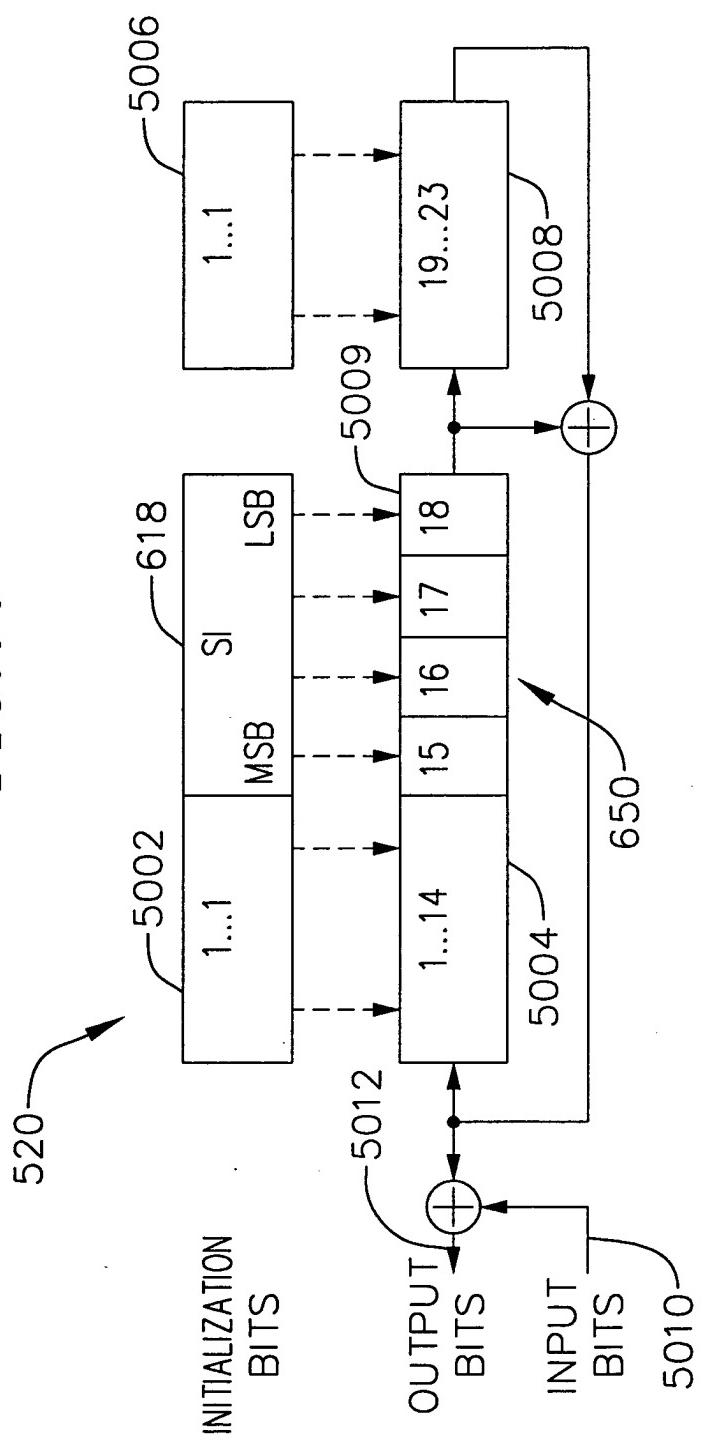


FIG. 12a

2 BITS PER BAUD

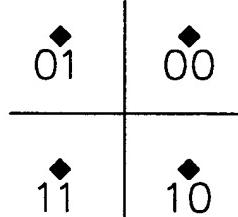


FIG. 12b
3 BITS PER BAUD

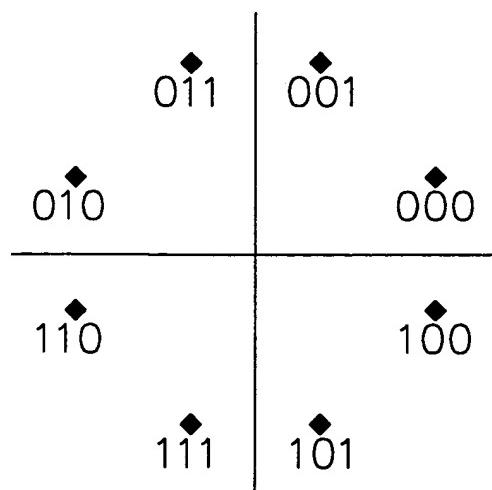


FIG. 12c

4 BITS PER BAUD

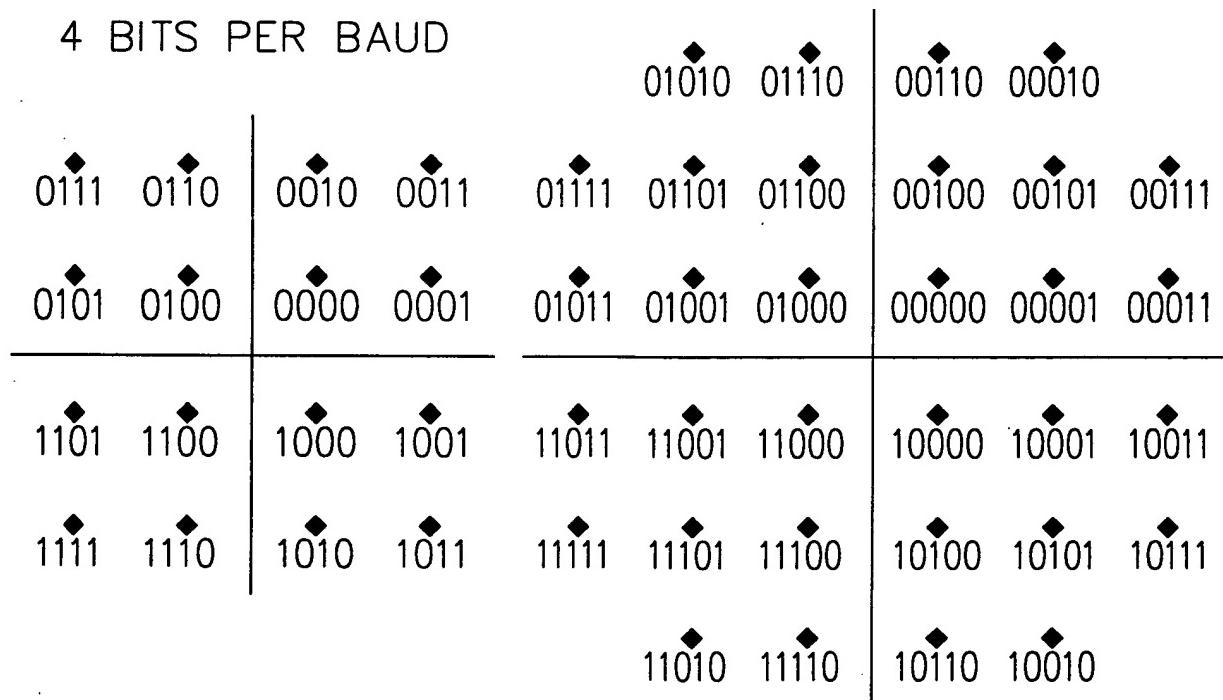


FIG. 12d

5 BITS PER BAUD

FIG. 12e

6 BITS PER BAUD

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| ◆ 011010 | ◆ 011011 | ◆ 011001 | ◆ 011000 | ◆ 001000 | ◆ 001001 | ◆ 001011 | ◆ 001010 |
| ◆ 011110 | ◆ 011111 | ◆ 011101 | ◆ 011100 | ◆ 001100 | ◆ 001101 | ◆ 001111 | ◆ 001110 |
| ◆ 010110 | ◆ 010111 | ◆ 010101 | ◆ 010100 | ◆ 000100 | ◆ 000101 | ◆ 000111 | ◆ 000110 |
| ◆ 010010 | ◆ 010011 | ◆ 010001 | ◆ 010000 | ◆ 000000 | ◆ 000001 | ◆ 000011 | ◆ 000010 |
| ◆ 110010 | ◆ 110011 | ◆ 110001 | ◆ 110000 | ◆ 100000 | ◆ 100001 | ◆ 100011 | ◆ 100010 |
| ◆ 110110 | ◆ 110111 | ◆ 110101 | ◆ 110100 | ◆ 100100 | ◆ 100101 | ◆ 100111 | ◆ 100110 |
| ◆ 111110 | ◆ 111111 | ◆ 111101 | ◆ 111100 | ◆ 101100 | ◆ 101101 | ◆ 101111 | ◆ 101110 |
| ◆ 111010 | ◆ 111011 | ◆ 111001 | ◆ 111000 | ◆ 101000 | ◆ 101001 | ◆ 101011 | ◆ 101010 |

FIG. 12f

7 BITS PER BAUD

| | | | | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| ◆ 0101100 | ◆ 0101101 | ◆ 0111101 | ◆ 0111100 | ◆ 0011100 | ◆ 0011101 | ◆ 0001101 | ◆ 0001100 |
| ◆ 0100100 | ◆ 0100101 | ◆ 0110101 | ◆ 0110100 | ◆ 0010100 | ◆ 0010101 | ◆ 0000101 | ◆ 0000100 |
| ◆ 0110111 | ◆ 0110110 | ◆ 0110010 | ◆ 0110001 | ◆ 0110000 | ◆ 0010000 | ◆ 0010001 | ◆ 0010010 |
| ◆ 0111111 | ◆ 0111110 | ◆ 0111010 | ◆ 0111001 | ◆ 0111000 | ◆ 0011000 | ◆ 0011001 | ◆ 0011010 |
| ◆ 0101111 | ◆ 0101110 | ◆ 0101010 | ◆ 0101001 | ◆ 0101000 | ◆ 0001000 | ◆ 0001001 | ◆ 0001010 |
| ◆ 0100111 | ◆ 0100110 | ◆ 0100010 | ◆ 0100001 | ◆ 0100000 | ◆ 0000000 | ◆ 0000001 | ◆ 0000010 |
| ◆ 1100111 | ◆ 1100110 | ◆ 1100010 | ◆ 1100001 | ◆ 1100000 | ◆ 1000000 | ◆ 1000001 | ◆ 1000010 |
| ◆ 1101111 | ◆ 1101110 | ◆ 1101010 | ◆ 1101001 | ◆ 1101000 | ◆ 1001000 | ◆ 1001001 | ◆ 1001010 |
| ◆ 1111111 | ◆ 1111110 | ◆ 1111010 | ◆ 1111001 | ◆ 1111000 | ◆ 1011000 | ◆ 1011001 | ◆ 1011010 |
| ◆ 1110111 | ◆ 1110110 | ◆ 1110010 | ◆ 1110001 | ◆ 1110000 | ◆ 1010000 | ◆ 1010001 | ◆ 1010010 |
| ◆ 1100100 | ◆ 1100101 | ◆ 1110101 | ◆ 1110100 | ◆ 1010100 | ◆ 1010101 | ◆ 1000101 | ◆ 1000100 |
| ◆ 1101100 | ◆ 1101101 | ◆ 1111101 | ◆ 1111100 | ◆ 1011100 | ◆ 1011101 | ◆ 1001101 | ◆ 1001100 |

FIG. 12g
 8 BITS PER BAUD

| | |
|--|--|
| ◆ 01100100 01100101 01100111 01100110 01100010 01100011 01100000 | ◆ 00100000 00100001 00100011 00100010 00100010 00100011 00100010 |
| ◆ 01101100 01101101 01101111 01101110 01101010 01101011 01101000 | ◆ 00101000 00101001 00101011 00101010 00101010 00101011 00101010 |
| ◆ 01111100 01111101 01111111 01111110 01111010 01111011 01111000 | ◆ 00111000 00111001 00111011 00111010 00111010 00111011 00111000 |
| ◆ 01110100 01110101 01110111 01110110 01110010 01110011 01110000 | ◆ 00110000 00110001 00110011 00110010 00110010 00110011 00110000 |
| ◆ 01010100 01010101 01010111 01010110 01010010 01010011 01010000 | ◆ 00010000 00010001 00010011 00010010 00010010 00010011 00010000 |
| ◆ 01011100 01011101 01011111 01011110 01011010 01011011 01011000 | ◆ 00011000 00011001 00011011 00011010 00011010 00011011 00011000 |
| ◆ 01001100 01001101 01001111 01001110 01001010 01001011 01001000 | ◆ 00001000 00001001 00001011 00001010 00001010 00001011 00001000 |
| ◆ 01000100 01000101 01000111 01000110 01000010 01000011 01000000 | ◆ 00000000 00000001 00000011 00000010 00000010 00000011 00000000 |
| ◆ 11000100 11000101 11000111 11000110 11000010 11000011 11000000 | ◆ 10000000 10000001 10000011 10000010 10000010 10000011 10000000 |
| ◆ 11001100 11001101 11001111 11001110 11001010 11001011 11001000 | ◆ 10001000 10001001 10001011 10001010 10001010 10001011 10001000 |
| ◆ 11011100 11011101 11011111 11011110 11011010 11011011 11011000 | ◆ 10011000 10011001 10011011 10011010 10011010 10011011 10011000 |
| ◆ 11010100 11010101 11010111 11010110 11010010 11010011 11010000 | ◆ 10010000 10010001 10010011 10010010 10010010 10010011 10010000 |
| ◆ 11110100 11110101 11110111 11110110 11110010 11110011 11110000 | ◆ 10110000 10110001 10110011 10110010 10110010 10110011 10110000 |
| ◆ 11111100 11111101 11111111 11111110 11111010 11111011 11111000 | ◆ 10111000 10111001 10111011 10111010 10111010 10111011 10111000 |
| ◆ 11101100 11101101 11101111 11101110 11101010 11101011 11101000 | ◆ 10101000 10101001 10101011 10101010 10101010 10101011 10101000 |
| ◆ 11100100 11100101 11100111 11100110 11100010 11100011 11100000 | ◆ 10100000 10100001 10100011 10100010 10100010 10100011 10100000 |

FIG. 13

| BITS PER BAUD | REFERENCE POINT(S) | VALUE |
|---------------|--------------------|----------------------------|
| 2 | 00 | $1+i$ |
| 3 | 000 001 | $(12+5i)/9$ $(5+12i)/9$ |
| 4 | 0000 | $(1+i)/3$ |
| 5 | 00000 | $(1+i)/4$ |
| 6 | 000000 | $(1+i)/7$ |
| 7 | 0000000 | $(1+i)/9$ |
| 8 | 00000000 | $(1+i)/15$ |

FIG. 14

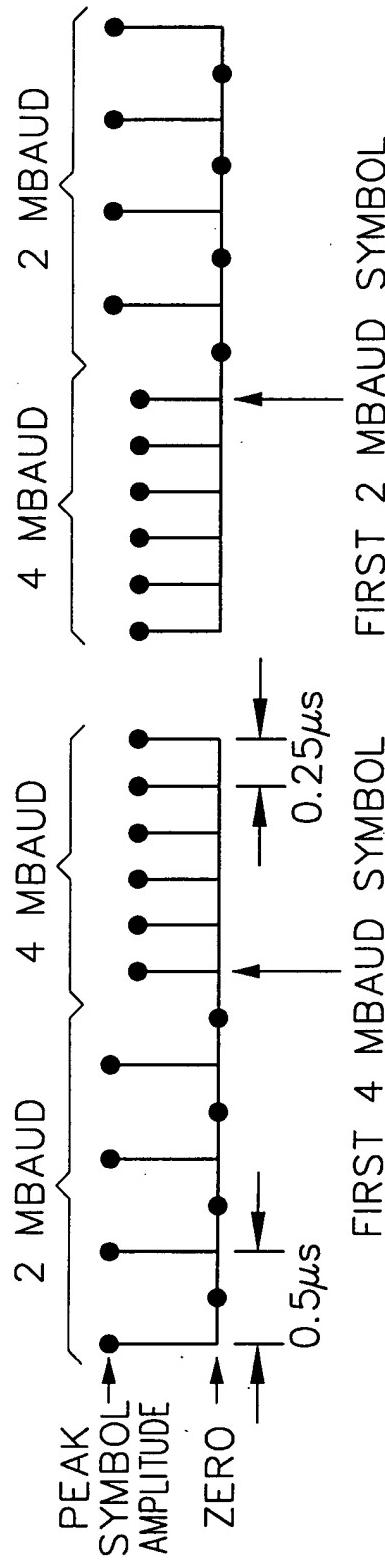
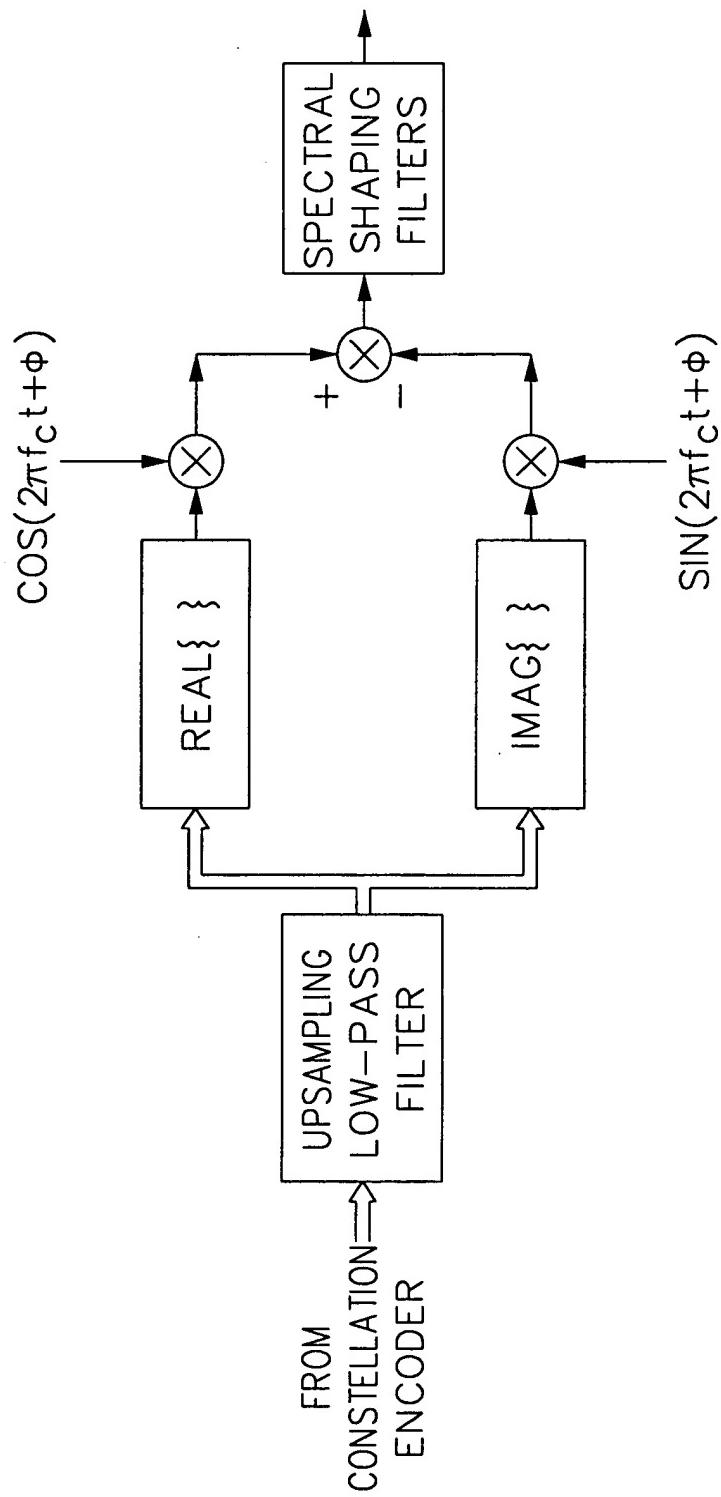


FIG. 15



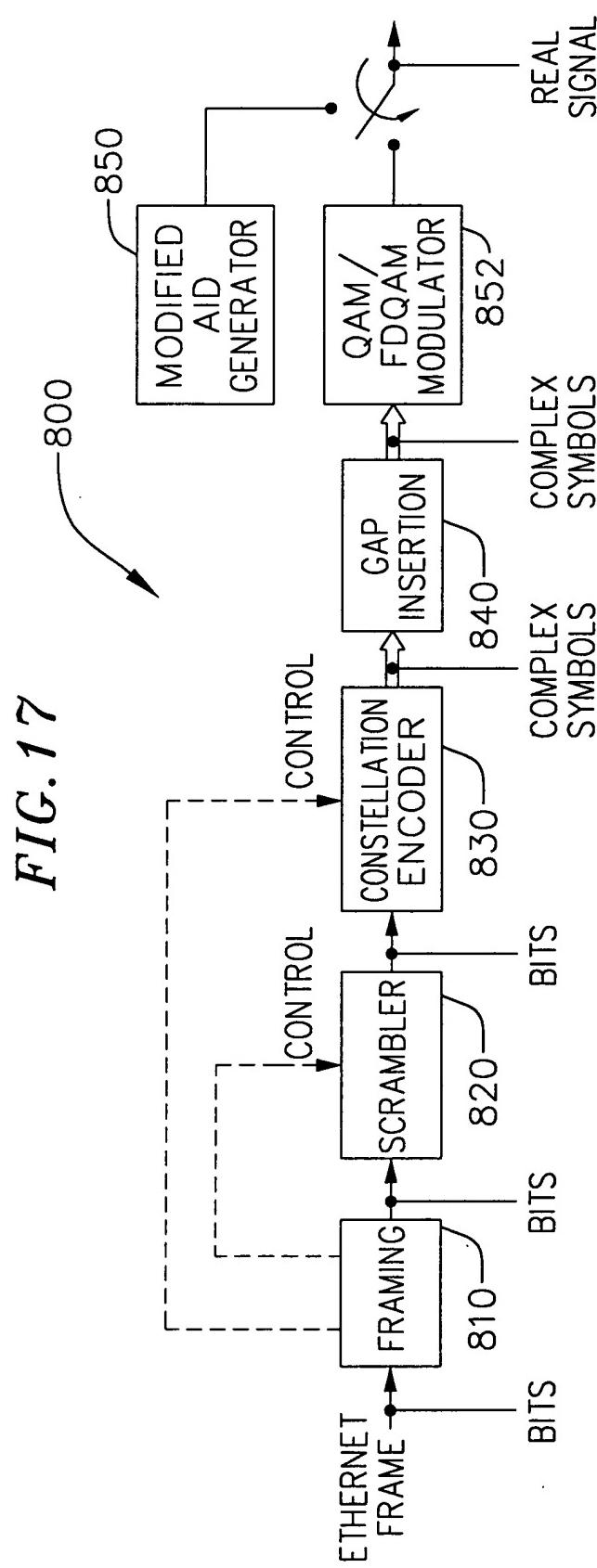
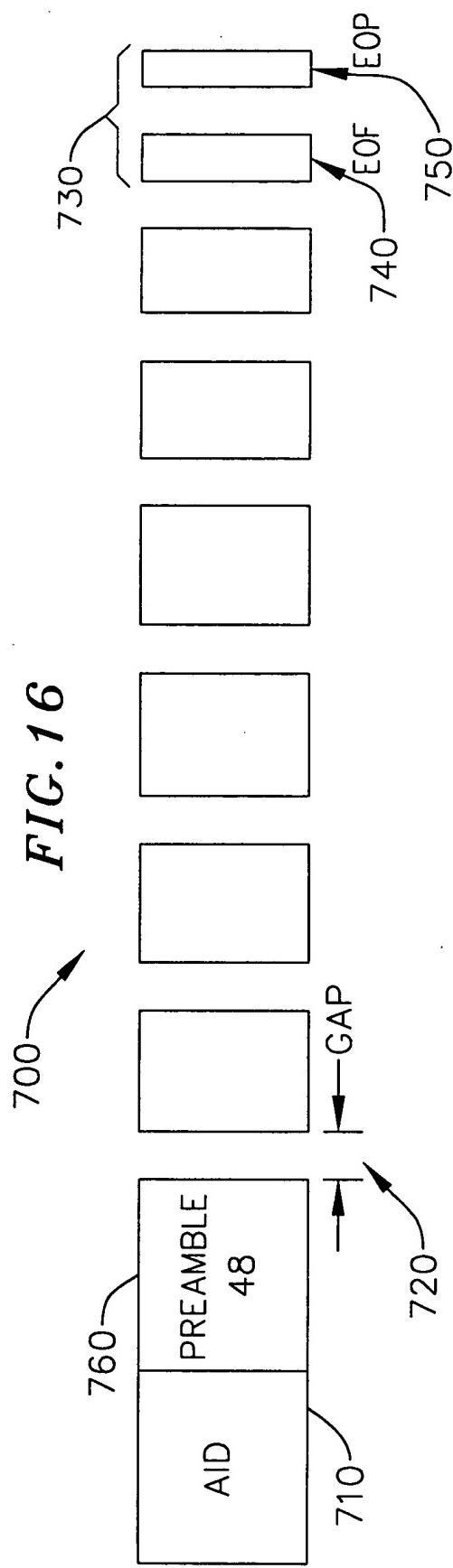


FIG. 18

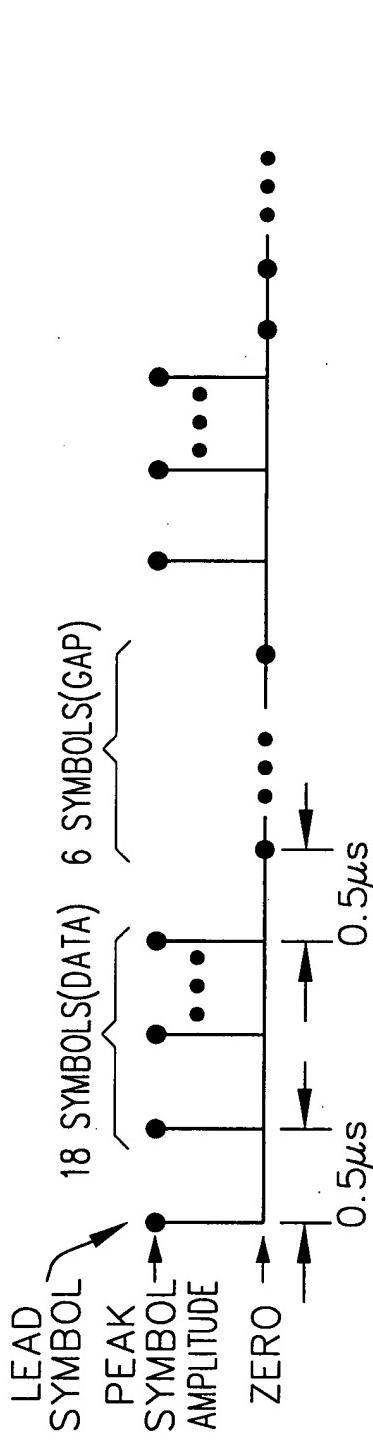


FIG. 19

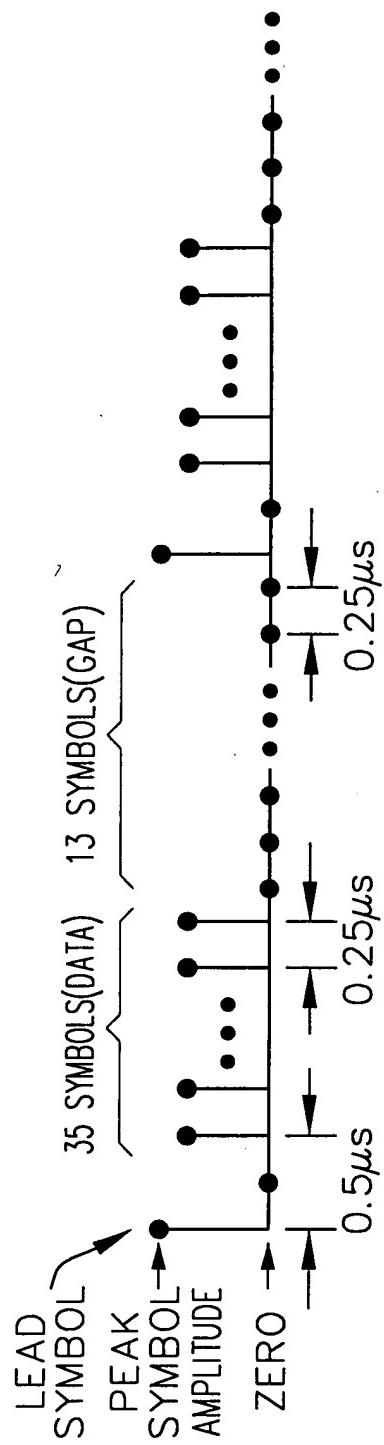


FIG. 20

| M MODULO 2 | P MODULO 2 | EOF /EOP SEQUENCE |
|------------|------------|--|
| 0 | 0 | <ul style="list-style-type: none">• 4 SYMBOLS, DEFINED BY THE BITS 0xfc• 12 ZERO SYMBOLS• 1 SYMBOL, DEFINED BY THE BITS 00 |
| 0 | 1 | <ul style="list-style-type: none">• 4 SYMBOLS, DEFINED BY THE BITS 0x03• 12 ZERO SYMBOLS• 1 SYMBOL, DEFINED BY THE BITS 11 |
| 1 | 0 | <ul style="list-style-type: none">• 4 SYMBOLS, DEFINED BY THE BITS 0x03• 12 ZERO SYMBOLS• 1 SYMBOL, DEFINED BY THE BITS 11 |
| 1 | 1 | <ul style="list-style-type: none">• 4 SYMBOLS, DEFINED BY THE BITS 0xfc• 12 ZERO SYMBOLS• 1 SYMBOL, DEFINED BY THE BITS 00 |

FIG. 21

| M MODULO 2 | P MODULO 4 | EOF/EOP SEQUENCE |
|------------|------------|--|
| 0 | 0 | • 4 SYMBOLS, DEFINED BY THE BITS 0xfc • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 00 |
| 0 | 1 | • 4 SYMBOLS, DEFINED BY THE BITS 0x56 • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 10 |
| 0 | 2 | • 4 SYMBOLS, DEFINED BY THE BITS 0x03 • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 11 |
| 0 | 3 | • 4 SYMBOLS, DEFINED BY THE BITS 0xa9 • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 01 |
| 1 | 0 | • 4 SYMBOLS, DEFINED BY THE BITS 0x03 • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 11 |
| 1 | 1 | • 4 SYMBOLS, DEFINED BY THE BITS 0xa9 • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 01 |
| 1 | 2 | • 4 SYMBOLS, DEFINED BY THE BITS 0xfc • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 00 |
| 1 | 3 | • 4 SYMBOLS, DEFINED BY THE BITS 0x56 • 12 ZERO SYMBOLS • 1 SYMBOL, DEFINED BY THE BITS 10 |

FIG. 22

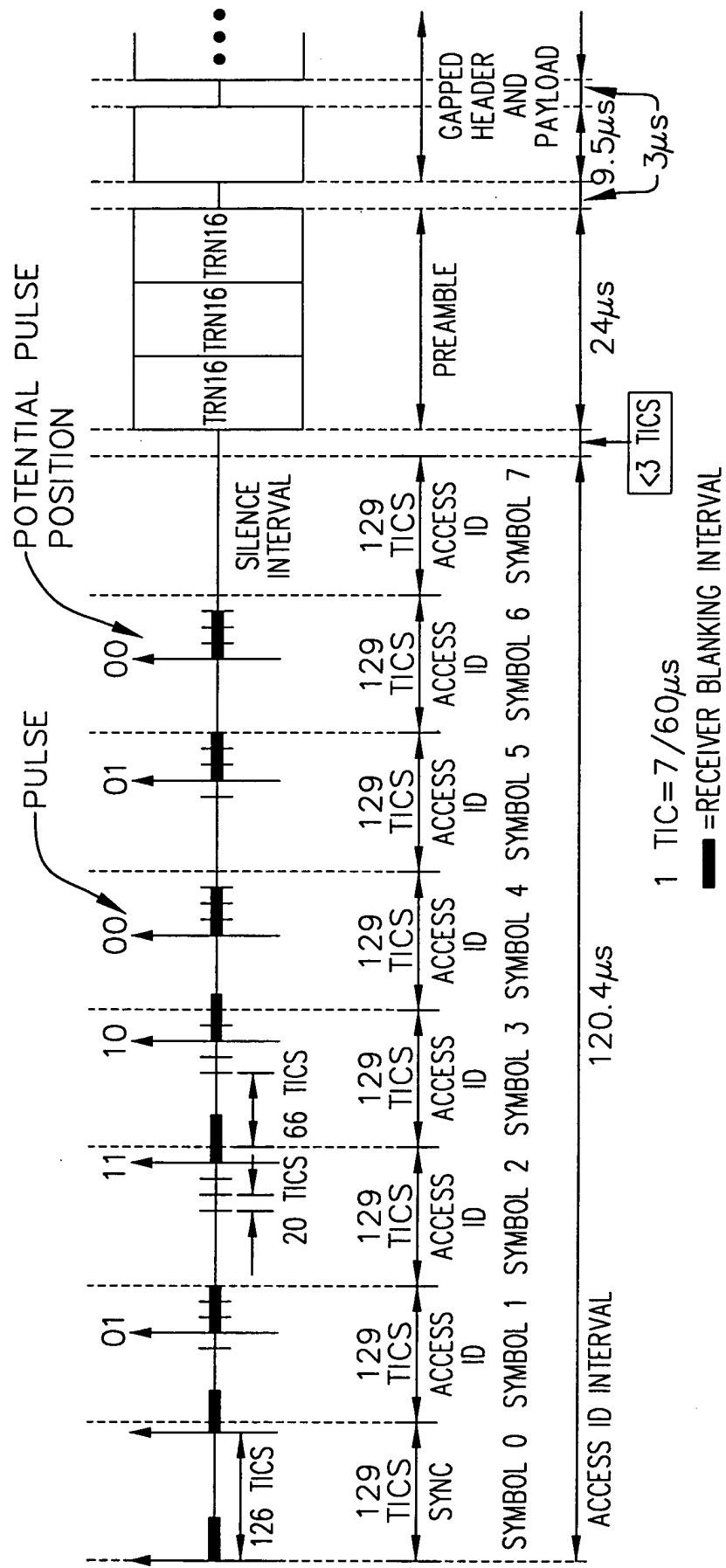


FIG.23a

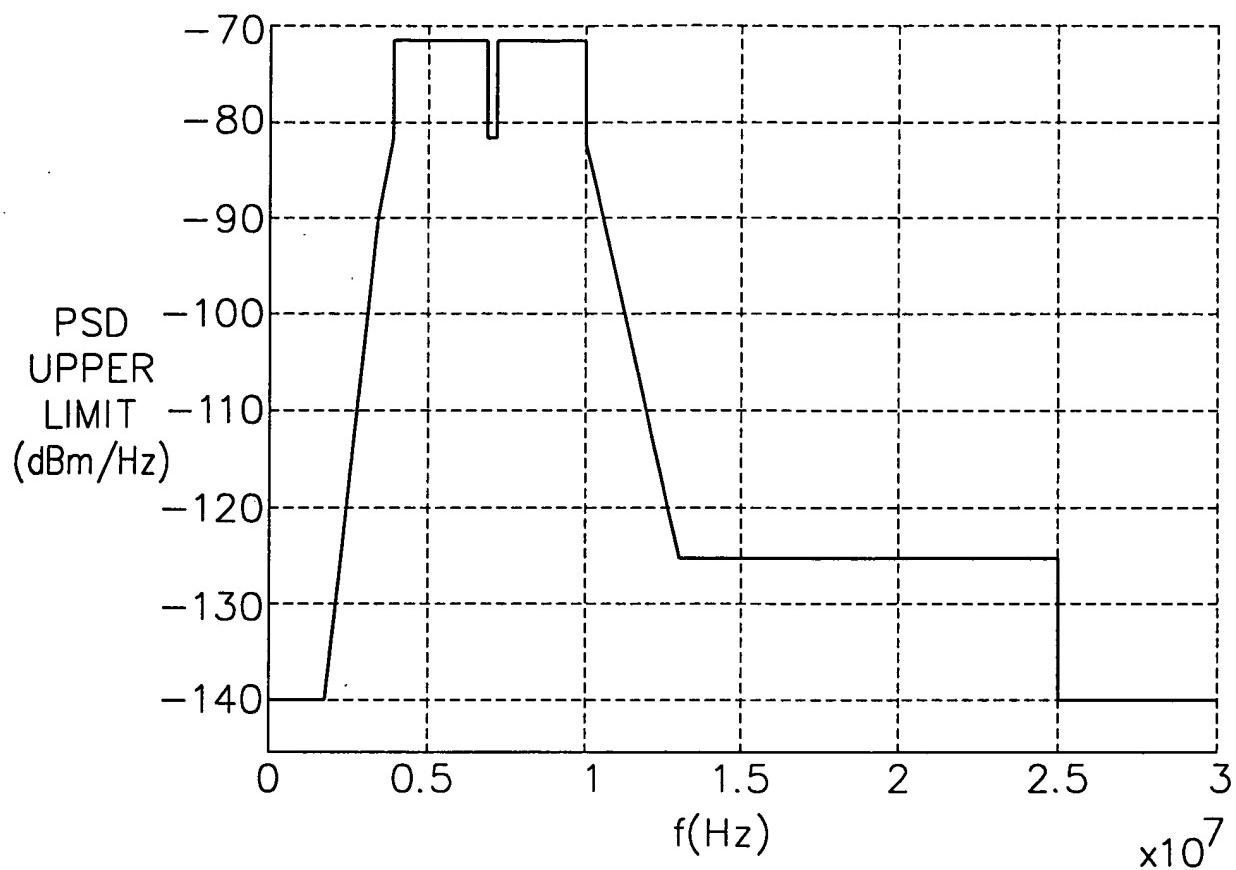


FIG.23b

| FREQUENCY(MHz) | PSD LIMIT(dBm/Hz) |
|----------------------|-----------------------------------|
| $0.015 < f \leq 1.7$ | -140 |
| $1.7 < f \leq 3.5$ | $-140 + (f - 1.7) * 50.0 / 1.8$ |
| $3.5 < f \leq 4.0$ | $-90 + (f - 3.5) * 17.0$ |
| $4.0 < f \leq 7.0$ | -71.5 |
| $7.0 < f \leq 7.3$ | -81.5 |
| $7.3 < f \leq 10.0$ | -71.5 |
| $10.0 < f \leq 13.0$ | $-81.5 - (f - 10.0) * 43.5 / 3.0$ |
| $13.0 < f \leq 25.0$ | -125 |
| $25.0 < f \leq 30.0$ | -140 |

FIG. 24

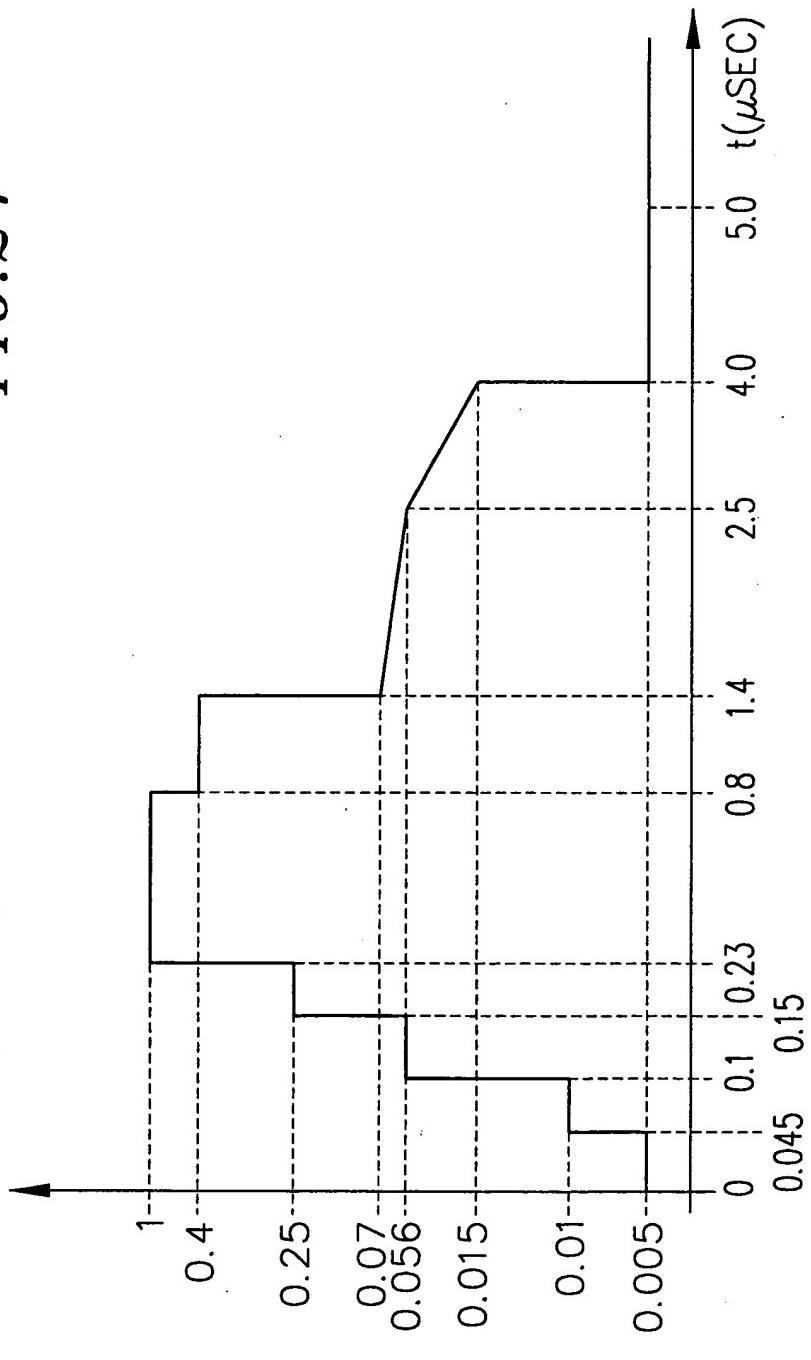


FIG.25

| FREQUENCY RANGE(MHz) | MAXIMUM PEAK-TO-PEAKINTERFERER LEVEL(VOLTS) |
|----------------------|---|
| 0.01-0.1 | 6.0 |
| 0.1-0.6 | 3.3 |
| 0.6-1.7 | 1.0 |
| 1.7-4.0 | 0.1 |
| 7.0-7.3 | 0.1 |
| 10.0-10.15 | 0.1 |
| 14.0-14.35 | 0.28 |
| 18.068-18.168 | 0.5 |
| 21.0-21.45 | 0.5 |
| 24.89-24.99 | 0.5 |
| 28.0-29.7 | 0.5 |

FIG.26

| FREQUENCY RANGE(MHz) | MAXIMUM PEAK-TO-PEAKINTERFERER LEVEL(VOLTS) |
|----------------------|---|
| 0.01-0.1 | 20.0 |
| 0.1-0.6 | 20.0 |
| 0.6-1.7 | 10.0 |
| 1.7-4.0 | 2.5 |
| 7.0-7.3 | 2.5 |
| 10.0-10.15 | 2.5 |
| 14.0-14.35 | 5.0 |
| 18.068-18.168 | 5.0 |
| 21.0-21.45 | 5.0 |
| 24.89-24.99 | 5.0 |
| 28.0-29.7 | 5.0 |

FIG.27

| FREQUENCY RANGE(kHz) | MIN.IMPEDANCE(OHMS) |
|----------------------|---------------------|
| 0<f<=0.285 | 1 M |
| 0.285<f<=2.85 | 100 k |
| 2.85<f<=28.5 | 10 k |
| 28.5<f<=95 | 4.0 k |
| 95<f<=190 | 2.0 k |
| 190<f<=285 | 1.4 k |
| 285<f<=380 | 1.0 k |
| 380<f<=475 | 850 |
| 475<f<=570 | 700 |
| 570<f<=665 | 600 |
| 665<f<=760 | 525 |
| 760<f<=855 | 450 |
| 855<f<=950 | 400 |
| 950<f<=1000 | 350 |
| 1000<f<=1400 | 175 |
| 1400<f<=2300 | 100 |
| 2300<f<=2850 | 50 |
| 2850<f<=3085 | 25 |
| 3085<f<=3725 | 10 |
| 3725<f<=3935 | 25 |
| 3935<f<=4000 | 50 |
| 10000<f<=10450 | 40 |
| 10450<f<=10925 | 25 |
| 10925<f<=13125 | 10 |
| 13125<f<=14175 | 25 |
| 14175<f<=16800 | 50 |
| 16800<f<=21000 | 100 |
| 21000<f<=30000 | 50 |

FIG. 28

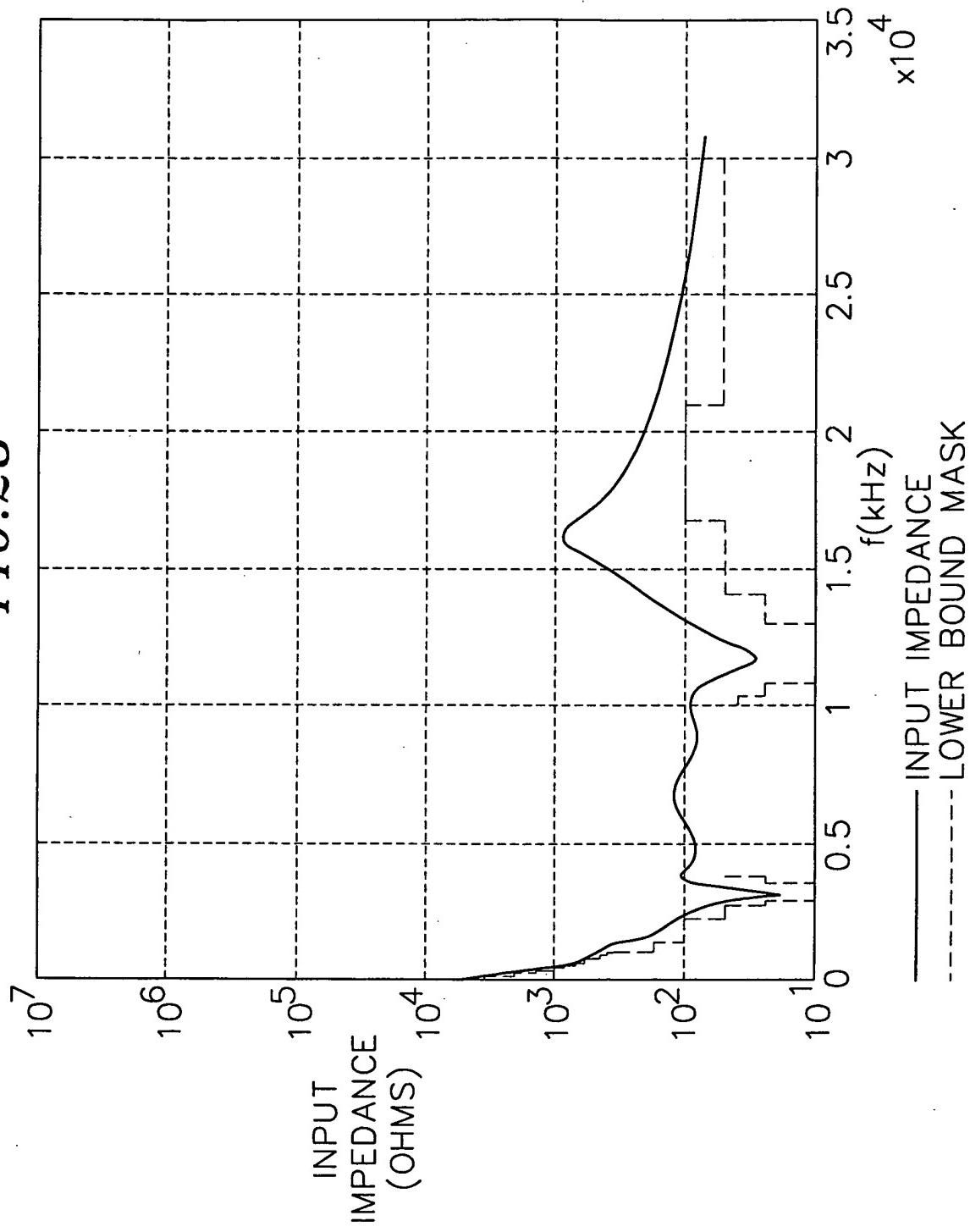


FIG. 29

| OSI | IEEE | FUNCTION |
|--------------------------|--------------------------------|---|
| DATA LINK | - | LINK LAYER SIGNALING(DRIVER) a) RATE ADAPTATION, QoS AND 1M8 COMPATIBILITY b) LARQ ERROR RECOVERY c) LINK INTEGRITY AND CAPABILITY DISCOVERY |
| MAC CONTROLLER | MAC CONTROLLER LAYER FUNCTIONS | a) HOST INTERFACE b) CONTROL AND STATUS REGISTERS, INTERRUPTS c) DMA TRANSFERS, DATA BUFFERING AND COMMAND LIST INTERPRETATION d) PERFORMANCE COUNTERS e) MAC ADDRESS FILTERING, WAKE-ON-LAN PROCESSING |
| MII | | OPTIONAL MII INTERFACE (IN PHY-ONLY) |
| LLC-LOGICAL LINK CONTROL | | OPTIONAL LINK LAYER SIGNALING (IN PHY-ONLY) a) RATE ADAPTATION, QoS AND 1M8 COMPATIBILITY b) c) LINK INTEGRITY AND CAPABILITY DISCOVERY |
| V2 MAC | | FRAME PROCESSING (TRANSMIT AND RECEIVE) a) FRAMING (FRAME BOUNDARY DELINEATION AND SYNCHRONIZATION) b) ERROR DETECTION (FCS GENERATION AND CHECK, FRAGMENT DETECTION) |
| PHY | MAC ACCESS CONTROL (MAC) | a) CSMA/CD b) COLLISION RESOLUTION (BACKOFF ALGORITHM) |
| PHY | PHYSICAL CODING SUBLAYER | PHYSICAL CODING SUBLAYER a) CODING AND MODULATION, CARRIER SENSE, COLLISION DETECTION |

FIG. 30

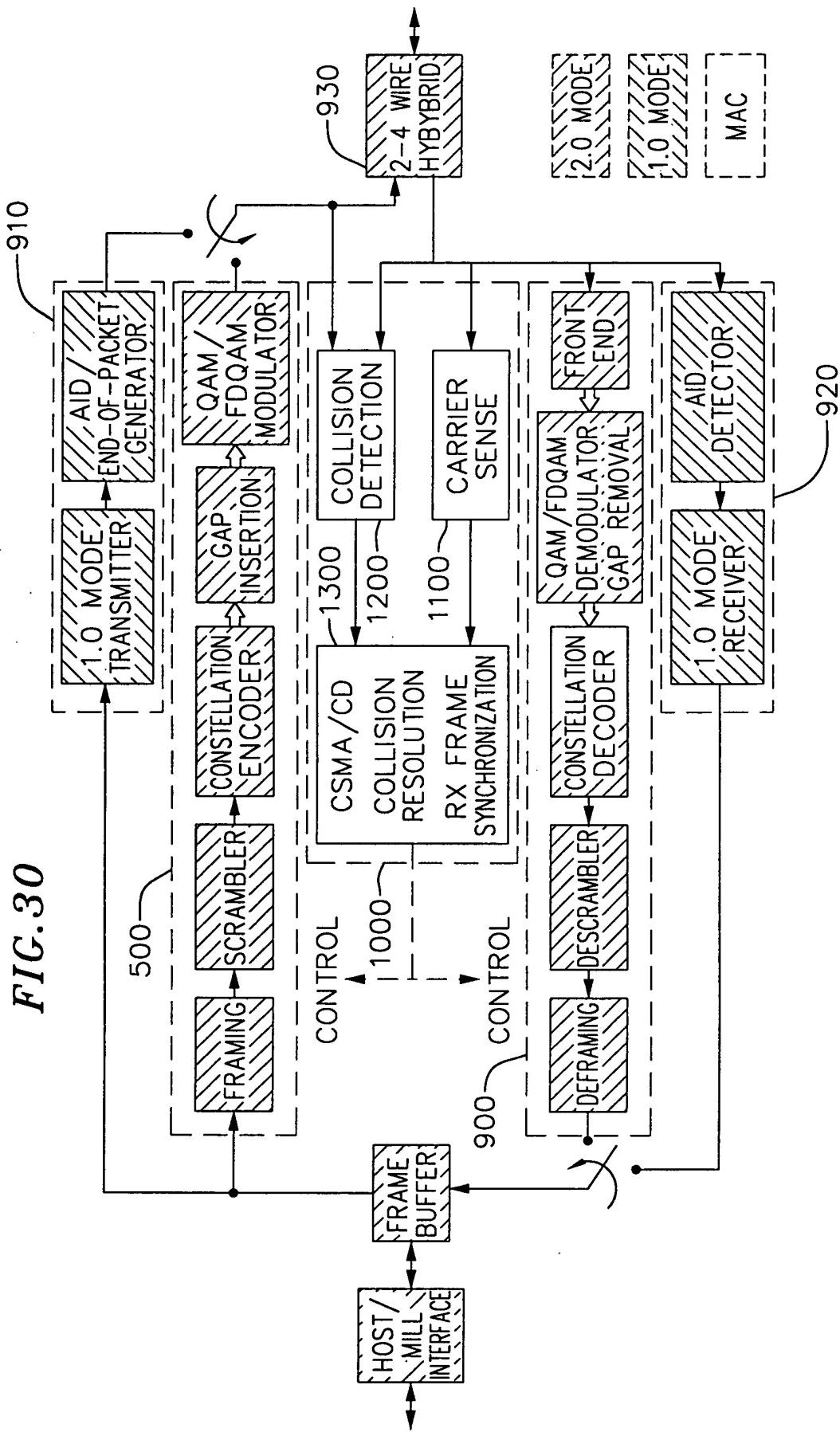


FIG. 31

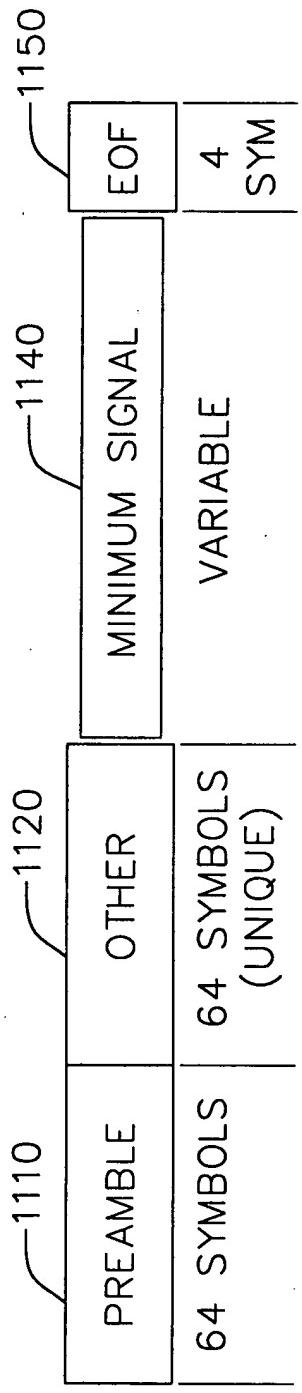


FIG. 32

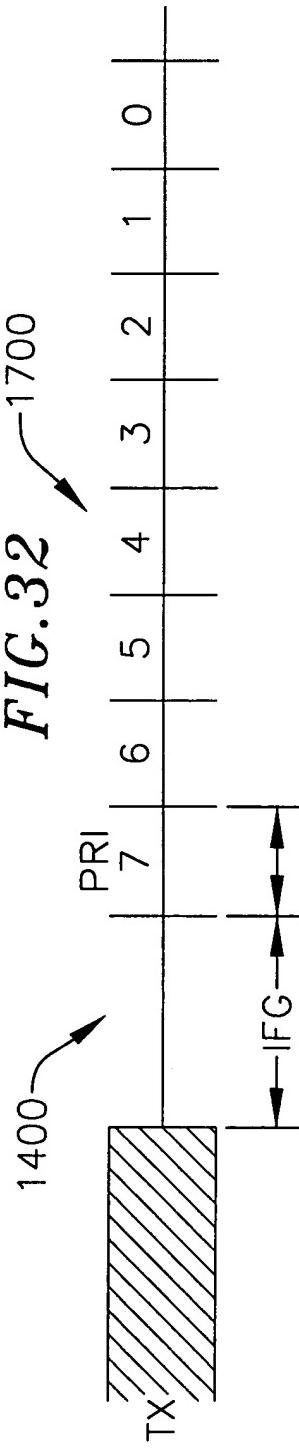
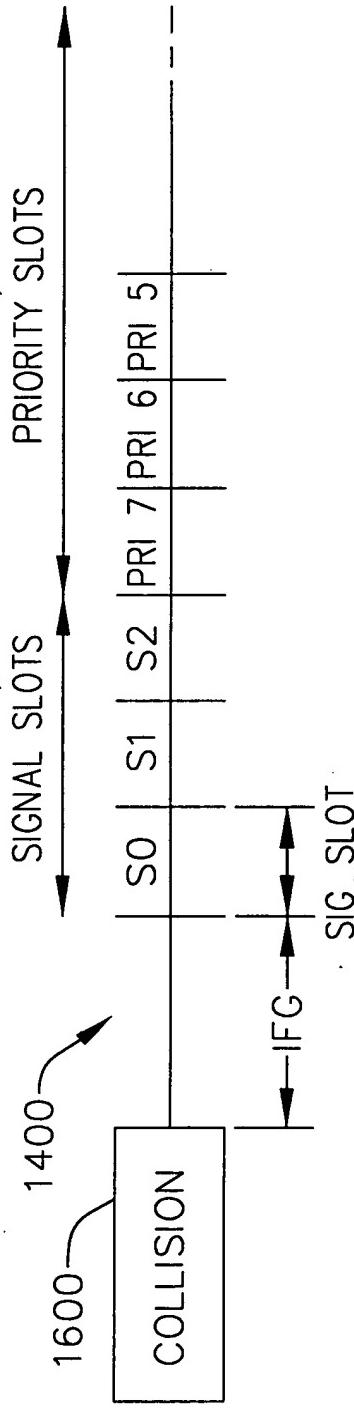


FIG. 33



WITHOUT PRIORITY ACCESS:

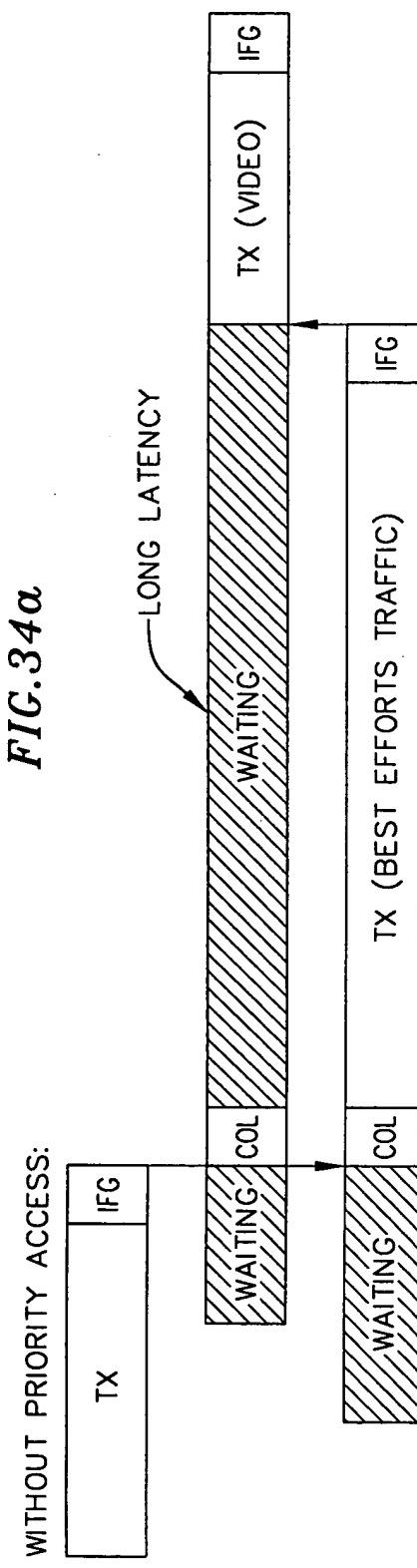


FIG. 34a

WITH PRIORITY ACCESS:

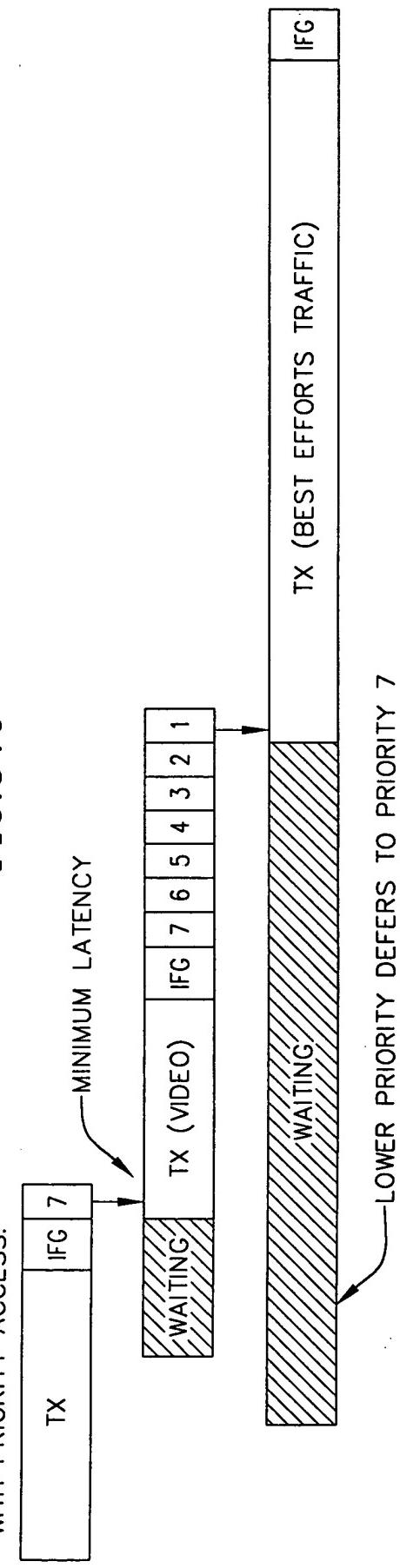


FIG. 34b

FIG. 35

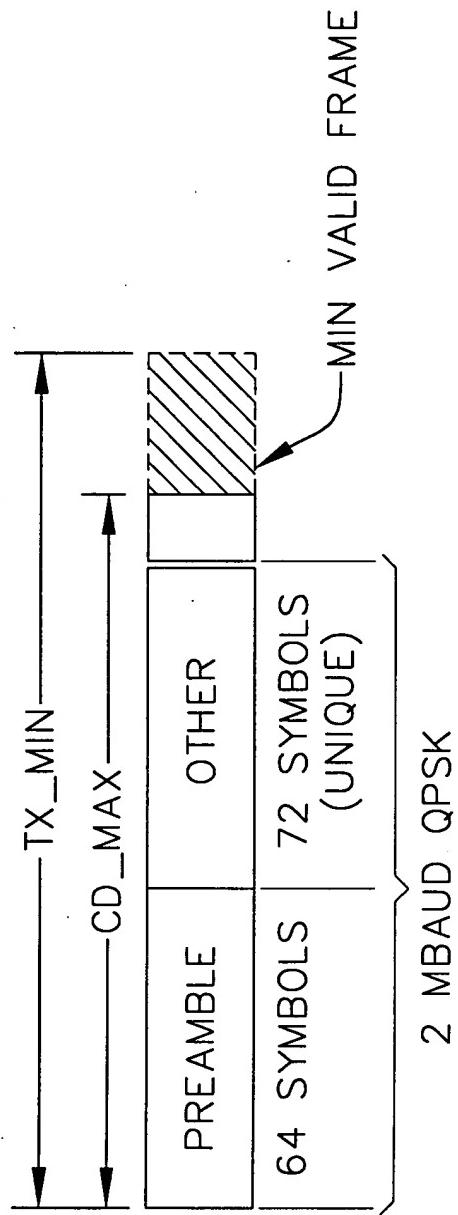


FIG. 36

| SECTION | PARAMETER | MIN | MAX | UNITS |
|---------------------|----------------------------|--------|-------------|--------------|
| BASIC CSMA | NOMINAL_RMS_VOLTAGE | 100 | — | mVrms |
| | CS_RANGE | 38 | — | dB |
| | CS_IFG | 29.0-Δ | 29.0+Δ | MICROSECONDS |
| | CS_DEFER | — | 12.0 | MICROSECONDS |
| | MINFRAMESIZE | 64 | — | OCTETS |
| | MAXFRAMESIZE | 1526 | SEE 3.3.7.1 | OCTETS |
| | TX_FRAME | 92.5 | SEE 3.3.7.1 | MICROSECONDS |
| | TX_ON | 0 | 4.0 | MICROSECONDS |
| PRIORITY ACCESS | PRI_SLOT | 21.0-Δ | 21.0+Δ | MICROSECONDS |
| COLLISION DETECTION | CD_FRAG | 70.0-Δ | 70.0+Δ | MICROSECONDS |
| | CD_MIN | 32.0 | — | MICROSECONDS |
| | CD_THRESHOLD (RECOMMENDED) | — | 92.0 | MICROSECONDS |
| | CD_RANGE | 36 | — | dB |
| | CD_OFFSET_EARLY | — | 12.0 | MICROSECONDS |
| | CD_OFFSET_LATE | — | 15.0 | MICROSECONDS |
| | ATTEMPTLIMIT | 256 | 256 | |
| | SIG_SLOT | 32.0-Δ | 32.0+Δ | MICROSECONDS |

FIG. 37

| FIELD | LENGTH | EXPLANATION |
|----------------|--------------|---|
| DA | 6 OCTETS | DESTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK PROTOCOL FRAME. ASSIGNED TO ASSIGNEE BY IEEE) |
| SSTYPE | 1 OCTET | <ul style="list-style-type: none"> 0-RESERVED 1-RATE REQUEST CONTROL FRAME 2-LINK INTEGRITY SHORT FRAME 3-CAPABILITIES ANNOUNCEMENT 4-LARQ 5-VENDOR-SPECIFIC SHORT FORMAT TYPE 6-126 RESERVED 127 RESERVED VALUES 128-255 CORRESPOND TO THE LONG SUBTYPE |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD (OR THE FIRST OCTET FOLLOWING SSLENGTH IF IT IS NOT DEFINED AS SSVERSION) AND ENDING WITH THE SECOND (LAST) OCTET OF THE NEXT ETHERTYPE FIELD. MIN IS 2 AND MAX IS 255 |
| SSVERSION | 1 OCTET | VERSION NUMBER OF THE CONTROL INFORMATION |
| DATA | 0-252 OCTETS | CONTROL INFORMATION |
| NEXT ETHERTYPE | 2 OCTETS | ETHERTYPE/LENGTH OF NEXT LAYER PROTOCOL, 0 IF NONE. |
| PAD | 41-0 OCTETS | PADDING REQUIRED TO MEET MINIMUM IF DATA<41 OCTETS |
| FCS | 4 OCTETS | FRAME CHECK SEQUENCE |

FIG. 38

| FIELD | LENGTH | EXPLANATION |
|----------------|-------------------|--|
| DA | 6 OCTETS | DÉSTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK PROTOCOL FRAME, ASSIGNED TO EPICRAM BY IEEE) |
| LTYPE | 2 OCTETS | <p>32768 RESERVED</p> <p>32769 VENDOR-SPECIFIC LONG-FORMAT</p> <p>32770-65534 RESERVED</p> <p>65535 RESERVED</p> |
| LSLENGTH | 2 OCTETS | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD (OR THE FIRST OCTET FOLLOWING SSLENGTH IF IT IS NOT DEFINED AS SSVERSION) AND ENDING WITH THE SECOND (LAST) OCTET OF THE NEXT ETHERTYPE FIELD. MIN IS 2 AND MAX IS 65535. |
| SSVERSION | 1 OCTET | VERSION NUMBER OF THE FOLLOWING PROTOCOL INFORMATION |
| DATA | LSLENGTH-3 OCTETS | ETHERTYPE/PROTOCOL DEPENDENT DATA |
| NEXT ETHERTYPE | 2 OCTETS | ETHERTYPE/LENGTH OF NEXT LAYER PROTOCOL, 0 IF NONE. |
| PAD | 42-0 OCTETS | PAD TO MINIMUM SIZE IF NEEDED |
| FCS | 4 OCTETS | FRAME CHECK SEQUENCE |

FIG.39

| FIELD | LENGTH | MEANING |
|----------------|----------|---|
| DA | 6 OCTETS | DESTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =1 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. THE MINIMUM VALUE OF SSLENGTH IS 8 FOR SSVERSION 0. |
| SSVERSION | 1 OCTET | =0 |
| OPCODE | 1 OCTET | OPERATION CODE FOR THIS CONTROL MESSAGE. |
| NUMBANDS | 1 OCTET | NUMBER OF BANDS SPECIFIED IN THIS CONTROL. EACH BAND HAS A TWO OCTET DESCRIPTOR. THE FIRST BAND REFERS TO 2 MBAUD MODULATION RATE, THE NEXT TO 4 MBAUD. NUMBANDS SHALL BE 1 OR 2 ON TRANSMISSION FOR 10M8 STATIONS, AND STATIONS SHALL IGNORE BAND ENTRIES BEYOND BAND2 ON RECEIVE IF NUMBANDS IS LARGER THAN 2. THE VALUE 0 IS NOT ALLOWED. |
| NUMADDR | 1 OCTET | NUMBER OF ADDRESSES SPECIFIED IN THE PAYLOAD OF THIS CONTROL MESSAGE. NUMADDR MAY BE ZERO. THE SA IN THE ETHERNET HEADER IS ALWAYS USED, AND IS REFERRED TO IN THE FOLLOWING SECTIONS AS REFADDR. |
| BAND1_PE | 1 OCTET | 2MBAUD, 7 MHz CARRIER: THE PE VALUE THAT SHOULD BE USED TO SEND DATA WHEN THE 2MBAUD BAND IS SELECTED. (1..8)ARE THE ONLY VALID VALUES. THE VALUE 8 IS USED TO REQUEST HPNA 1.0 TYPE FRAMES, AND IS VALID ONLY WHEN THE NETWORK IS OPERATING IN V1M2MODE, AND ONLY IN BAND 1. |
| BAND1_RANK | 1 OCTET | THE RANK ORDER OF THE REQDAS' PREFERENCE FOR THIS BAND, 1 IS HIGHEST PREFERENCE, AND THE OTHER BANDS ARE ASSIGNED SUCCESSIVELY LARGER RANK VALUES, NO TWO BANDS SHALL HAVE THE SAME RANK. |
| BAND2_PE | 1 OCTET | OPTIONAL, ONLY PRESENT IF NUMBANDS>=2. 4MBAUD, 7 MHz CARRIER: IF INCLUDED, THIS FIELD IS THE PE VALUE THAT SHOULD BE USED TO SEND DATA WHEN THE 4MBAUD BAND IS SELECTED, (0,9..15) ARE THE ONLY VALID VALUES. |
| BAND2_RANK | 1 OCTET | OPTIONAL, ONLY PRESENT IF NUMBANDS>=2. RANK ORDER OF REQDAS' PREFERENCE FOR THIS BAND. |
| REFADDR1 | 6 OCTETS | OPTIONAL. PRESENT IF NUMADDR>=1. THE SECOND MAC ADDRESS FOR WHICH THE RATES ARE BEING SPECIFIED, TYPICALLY BROADCAST OR A MULTICAST ADDRESS. |
| REFADDR2 | 6 OCTETS | OPTIONAL. PRESENT IF NUMADDR>=2. THE THIRD MAC ADDRESS FOR WHICH THE RATES ARE BEING SPECIFIED. |
| ••• | | [ADDITIONAL INSTANCES OF REFADDR, UNTIL THE NUMBER OF REFADDR FIELDS EQUALS NUMADDR] |
| NEXT ETHERTYPE | 2 OCTETS | =0 |
| PAD | | TO REACH MINFRAMESIZE IF REQUIRED |
| FCS | 4 OCTETS | FRAME CHECK SEQUENCE |

FIG. 40

| PE | DATA RATE | MEANING |
|----|-----------|----------------------------------|
| 0 | N/A | MEANS THIS BAND IS NOT SUPPORTED |
| 1 | 4 MBIT/S | 2 MBAUD FDQAM, 2 BITS PER BAUD |
| 2 | 6 MBIT/S | 2 MBAUD FDQAM, 3 BITS PER BAUD |
| 3 | 8 MBIT/S | 2 MBAUD FDQAM, 4 BITS PER BAUD |
| 4 | 10 MBIT/S | 2 MBAUD FDQAM, 5 BITS PER BAUD |
| 5 | 12 MBIT/S | 2 MBAUD FDQAM, 6 BITS PER BAUD |
| 6 | 14 MBIT/S | 2 MBAUD FDQAM, 7 BITS PER BAUD |
| 7 | 16 MBIT/S | 2 MBAUD FDQAM, 8 BITS PER BAUD |
| 8 | 1 MBIT/S | HPNA 1.0 |
| 9 | 8 MBIT/S | 4 MBAUD QAM, 2 BITS PER BAUD |
| 10 | 12 MBIT/S | 4 MBAUD QAM, 3 BITS PER BAUD |
| 11 | 16 MBIT/S | 4 MBAUD QAM, 4 BITS PER BAUD |
| 12 | 20 MBIT/S | 4 MBAUD QAM, 5 BITS PER BAUD |
| 13 | 24 MBIT/S | 4 MBAUD QAM, 6 BITS PER BAUD |
| 14 | 28 MBIT/S | 4 MBAUD QAM, 7 BITS PER BAUD |
| 15 | 32 MBIT/S | 4 MBAUD QAM, 8 BITS PER BAUD |

FIG. 41

| OPCODE | MEANING |
|--------|---------------------|
| 0 | RATE CHANGE REQUEST |
| 1 | RATE TEST REQUEST |
| 2 | RATE TEST REPLY |
| 3-255 | RESERVED |

FIG. 42

| | |
|--------------------------|---|
| BAND SPECIFICATION | A PAYLOAD ENCODING (PE) AND RANK ASSOCIATED WITH A GIVEN BAND. A BAND IS A SINGLE COMBINATION OF BAUD RATE, MODULATION TYPE (E.G. QAM OR FDQAM) AND CARRIER FREQUENCY. TWO BANDS ARE DEFINED IN HPNAVZ |
| LOGICAL CHANNEL, CHANNEL | A FLOW OF FRAMES FROM A SENDER TO ONE OR MORE RECEIVERS ON A SINGLE NETWORK SEGMENT, CONSISTING OF ALL THE FRAMES WITH A SINGLE COMBINATION OF DA AND SA. |
| RECEIVER | A STATION THAT RECEIVES FRAMES SENT ON A PARTICULAR CHANNEL. IF THE DESTINATION IS A UNICAST ADDRESS THERE IS AT MOST ONE RECEIVER. IF THE DESTINATION IS A GROUP ADDRESS (INCLUDING BROADCAST), THERE MAY BE MANY RECEIVERS. |
| RECEIVER PE | THE PREFERRED PE TO BE USED ON THIS CHANNEL, AS DETERMINED BY THE RECEIVER. |
| RRCF | RATE REQUEST CONTROL FRAME. SENT FROM THE RECEIVER TO THE SENDER TO EFFECT A CHANGE IN PE. |
| REFADDR0 | THE SA IN THE ETHERNET HEADER OF THE RRCF FRAME. THIS IS THE DA OF THE RECEIVER (FOR THE CHANNEL), AND IS ALWAYS USED BY THE CHANNEL SENDER AS THE FIRST REFADDR PROCESSED. |
| REFADDR1.. REFADDR<n> | OTHER ADDRESSES INCLUDING BROADCAST AND MULTICAST ADDRESSES FOR WHICH THE RECEIVER IS INDICATING RATE INFORMATION TO THE SENDER. THE CHANNEL RECEIVER'S STATION ADDRESS (REFADDR0) SHOULD NOT BE PUT IN THE LIST OF ADDITIONAL REFADDR'S. NOTE 1: AT LEAST ONE REFADDR FIELD IS NECESSARY TO SUPPORT RATE NEGOTIATION FOR BROADCAST AND MULTICAST ADDRESSES SINCE THESE CANNOT BE USED AS THE SOURCE ADDRESS IN THE ETHERNET HEADER. |
| SENDER | THE SENDING STATION FOR A CHANNEL, USUALLY THE STATION OWNING THE SOURCE MAC ADDRESS. |
| SENDER PE | THE PREFERRED PE ASSOCIATED WITH A CHANNEL, AS NOTED BY THE SENDER. |

FIG. 43a

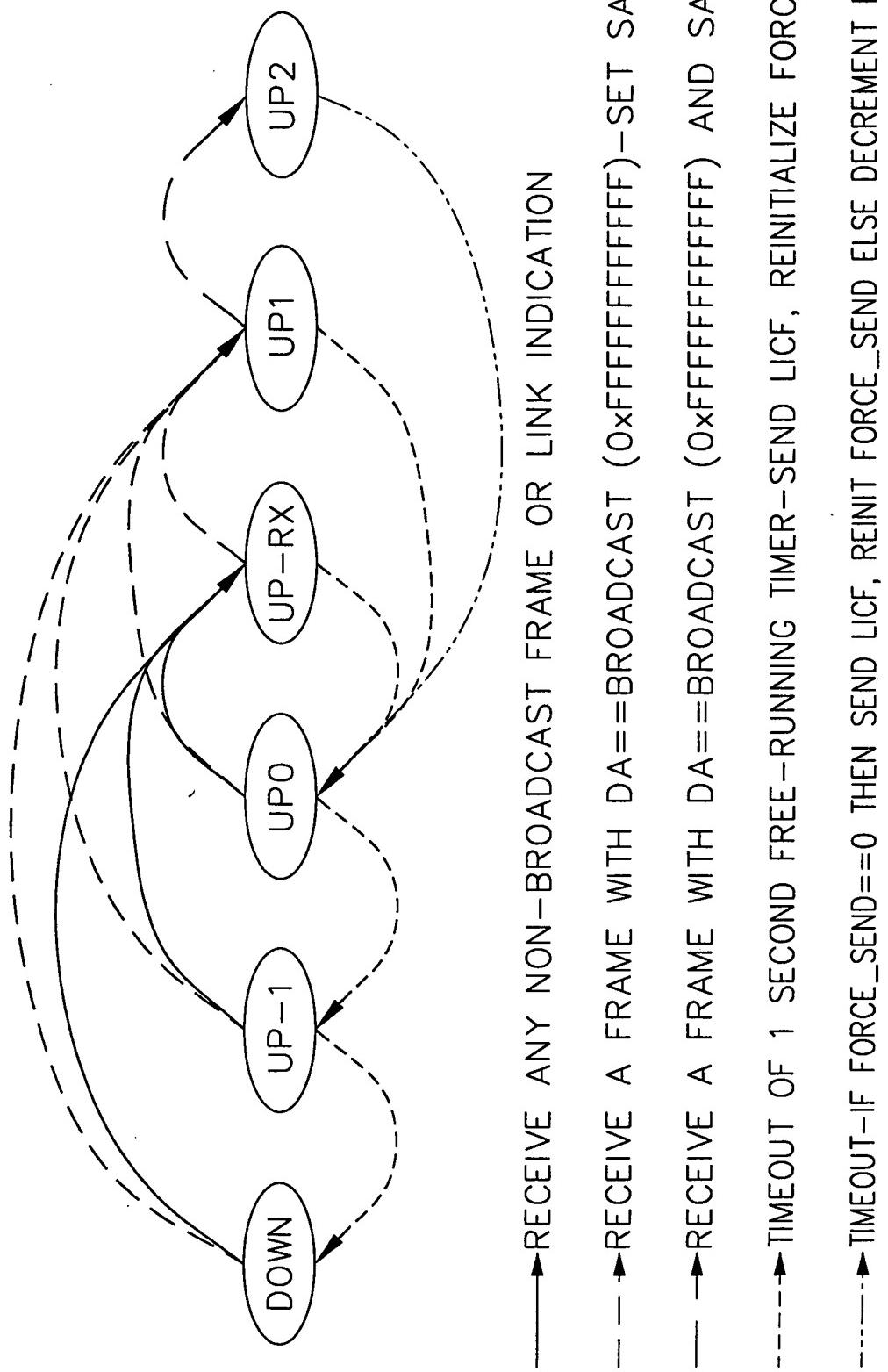


FIG. 43b

| | DOWN | UP -1 | UPO | UP-RX | UP1 | UP2 |
|--|--|--|--|---|---------------------------------------|---------------------------------------|
| RECEIVE 1.0 LINK INDICATION OR ANY NON-BROADCAST FRAME | UP-RX (NONE) | UP-RX (NONE) | UP-RX (NONE) | UP1 (NONE) | UP1 (NONE) | UP2 (NONE) |
| RECEIVE BROADCAST FRAME WITH SA=SA1 | UP1 SET SA1<-SA | UP1 SET SA1<-SA | UP1 SET SA1<-SA | UP1 SET SA1<-SA | UP1 SET SA1<-SA | UP2 (NONE) |
| RECEIVE BROADCAST FRAME WITH SA !=SA1 | UP1 SET SA1<-SA | UP1 SET SA1<-SA | UP1 SET SA1<-SA | UP1 SET SA1<-SA | NATIVE: UP2 COMPAT: UP1 (NONE) | UP2 (NONE) |
| TIMEOUT AND FORCE_SEND=0 | DOWN SEND LICF,REINIT FORCE_SEND | DOWN SEND LICF,REINIT FORCE_SEND | DOWN SEND LICF,REINIT FORCE_SEND | UP -1 SEND LICF,REINIT FORCE_SEND | UP0 SEND LICF,REINIT FORCE_SEND | UP0 SEND LICF,REINIT FORCE_SEND |
| TIMEOUT AND FORCE_SEND>0 | DOWN SEND LICF,REINIT FORCE_SEND | DOWN SEND LICF,REINIT FORCE_SEND | DOWN SEND LICF,REINIT FORCE_SEND | UP -1 SEND LICF,REINIT FORCE_SEND | UP0 SEND LICF,REINIT FORCE_SEND | UP0 DECREMENT FORCE_SEND |

FIG.44

| FIELD | LENGTH | MEANING |
|-------------------|-----------|--|
| DA | 6 OCTETS | DESTINATION ADDRESS (FF.FF.FF.FF.FF.FF) |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =2 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. MINIMUM IS 4 FOR SSVERSION 0. |
| SSVERSION | 1 OCTET | =0 |
| LI_PAD | 1 OCTET | IGNORED ON RECEPTION. |
| NEXT ETHERTYPE | 2 OCTETS | =0 |
| PAD | 41 OCTETS | ANY VALUE OCTET |
| FCS | 4 OCTETS | |

FIG. 45

| FIELD | LENGTH | MEANING |
|-------------------|----------|--|
| DA | 6 OCTETS | DESTINATION ADDRESS(FF.FF.FF.FF.FF.FF) |
| SA | 6 OCTETS | SOURCE ADDRESS OF THE STATION THAT TRANSMITTED THIS FRAME |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =3 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. MINIMUM IS 32 FOR SSVERSION 0. |
| SSVERSION | 1 OCTET | =0 |
| CSA_ID_SPACE | 1 OCTET | IDENTIFIES THE REGISTRATION SPACE OF CSA_MFR_ID 0-UNSPECIFIED 1-JEDEC 2-PCI |
| CSA_MFR_ID | 2 OCTETS | HW MANUFACTURER ID-IDENTIFIES THE MANUFACTURER OF THE PHY CONTROLLER CHIP. THE PURPOSE OF THIS FIELD PLUS THE PART NUMBER AND REVISION IS TO IDENTIFY SPECIFIC IMPLEMENTATIONS OF THE PHY SPECIFICATION. THIS IS NOT A BOARD OR ASSEMBLY-LEVEL IDENTIFIER. |
| CSA_PART_NO | 2 OCTETS | HW MANUFACTURER PART NUMBER-THE PART NUMBER OF THE PHY CONTROLLER CHIP. |
| CSA_REV | 1 OCTET | HW REVISION |
| CSA_OPCODE | 1 OCTET | 0-ANNOUNCE 1-REQUEST |
| CSA_MTU | 2 OCTETS | MAXIMUM SIZE LINK-LEVEL PDU THIS RECEIVER ACCEPTS IN OCTETS, THE DEFAULT VALUE IS 1526 OCTETS. THIS IS ALSO THE MINIMUM VALUE THAT SHALL BE ACCEPTED BY ALL IEEE10 STATIONS. |
| CSA_SA | 6 OCTETS | SOURCE ADDRESS OF THE STATION THAT GENERATED THIS CSA FRAME |
| CSA_PAD | 2 OCTETS | RESERVED FOR VERSION 0. SHALL BE SENT AS 0, IGNORED ON RECESSION. |
| CSA_CURRENTTXSET | 4 OCTETS | CONFIGURATION FLAGS, PLUS ALL CURRENT IN-USE STATUS FOR THIS STATION. |
| CSA_OLEDESTTXSET | 4 OCTETS | A COPY OF THE "OLDEST" TX FLAGS FOR THIS STATION, FROM THE PERIOD ENDING AT LEAST ONE PERIOD (MINUTE) EARLIER. |
| CSA_CURRENTRXSET | 4 OCTETS | THE UNION OF RECENT FLAGS RECEIVED FROM OTHER STATIONS. |
| NEXT ETHERTYPE | 2 OCTETS | =0 |
| PAD | | PAD TO REACH MINFRAMESIZE IF NECESSARY |
| FCS | 4 OCTETS | |

| Octet | Field | Length | Description |
|--------|-----------------|--------|--|
| Flags0 | TxPriority7 | 1 | Station is(was) transmitting frames with LL priority 7. (always set) |
| | TxPriority6 | 1 | Station is(was) transmitting frames with LL priority 6. |
| | TxPriority5 | 1 | Station is(was) transmitting frames with LL priority 5. |
| | TxPriority4 | 1 | Station is(was) transmitting frames with LL priority 4. |
| | TxPriority3 | 1 | Station is(was) transmitting frames with LL priority 3. |
| | TxPriority2 | 1 | Station is(was) transmitting frames with LL priority 2. |
| | TxPriority1 | 1 | Station is(was) transmitting frames with LL priority 1. |
| | TxPriority0 | 1 | Station is(was) transmitting frames with LL priority 0. (always set) |
| Flags1 | Reserved | 6 | Shall be sent as 0 and ignored by 2.0 stations when received. |
| | No_V1M2_Frames | 1 | This station does not support the reception or transmission of compatibility frames (V1M2 frames). |
| | Supports_4Mbps | 1 | This station supports 4 megabaud payload encodings. |
| Flags2 | Reserved | 8 | Shall be sent as 0 and ignored by 2.0 stations when received. |
| Flags3 | Config_V2 | 1 | Force use of 10M8 mode, defers to Config_V1 and Config_V1M2. |
| | Config_V1M2 | 1 | Force use of V1M2 mixed mode, defers to Config_V1. |
| | Config_V1 | 1 | Force use of HPNA 1.x mode, highest precedence of config flags. |
| | Reserved | 2 | Shall be sent as 0 and ignored by 2.0 stations when received. |
| | Highest_Version | 3 | This station's highest supported HPNA version: 0x000 - Reserved 0x001 - HPNA1.0 0x010 - iLine10 0x011-0x111 Reserved |

Fig. 46

| | |
|---------------------------------|---|
| DeleteSet | A computed value used to detect newly removed status information. |
| NewRxFlags, ReallyNewRxFlags | Computed values used to detect new status flags. |

Fig. 47

| | |
|-----------------|---|
| CSP_Timer | A free-running timer with a period of 60 seconds. |
| RetransmitTimer | A one-shot timer, set to a random interval in the range 1 ms to 1000 ms, inclusive, after sending a CSA in which CSA_CurrentTxSet and CSA_OldestTxSet are different, or when a CSA is received with the CSA_Opcode set to 1 (Request). This timer is cancelled if a second CSA is sent as a result of the CSP_Timer expiring. |

Fig. 48

| | |
|---------------|---|
| NewTxSet | The set of flags announced during the current CS period, updated immediately when a new link layer priority is used or new volatile status is set. When the CSP_Timer expires, CurrentTxSet is given the value of NewTxSet, and NewTxSet is reset to the default set. |
| PreviousTxSet | The set of flags that were announced during the previous CS period (the ending value of NewTxSet from the previous CS period). |
| OldestTxSet | The set of flags rolled over from PreviousTxSet at the end of the previous CS period (the value of PreviousTxSet from the previous CS period). Flags that are present in OldestTxSet and missing from PreviousTxSet were not actively used or detected (by the sender) for an entire CS period, and will be deleted. This set is sent in CSA frames as CSA_OldestTxSet. |
| NewRxSet | The union of all CSA_CurrentTxSet flags received in CSAs from other stations during the current CS period. This is rolled over into PreviousRxSet at the expiration of the CSP_Timer, then reset to the empty set (0). A volatile status flag (one of the priority flags) in this set may subsequently be deleted if the only station previously announcing that flag stops using it. The deletion from that station's CurrentTxSet is noted by the difference from its OldestTxSet. The fact that it was the only sender is noted by the absence of the flag in that station's CurrentRxSet, indicating that it has received the flag from no other stations. |
| PreviousRxSet | If deleted from NewRxSet, a flag shall also be deleted from PreviousRxSet. The set of announced flags received during the previous CS period (the ending value of NewRxSet from the previous CS period). A flag may be deleted from this set, as described under NewRxSet above. |

Fig. 49

| | |
|-----------------|---|
| CurrentTxSet | The set of flags that were announced during the previous CS period plus any new status and priority flags (or changed configuration/options flags) used during the current CS period, i.e. the union of PreviousTxSet and NewTxSet. This set is sent in CSA frames as CSA_CurrentTxSet. |
| CurrentRxSet | The union of NewRxSet, PreviousRxSet. This set is sent in CSA frames as CSA_CurrentRxSet. |
| CurrentInUseSet | The union of CurrentTxSet and CurrentRxSet. This set is used to determine the operational mode of the station and to modify the mapping between the LL priority of the frame and the actual PHY priority usage. |

Fig. 50

FIG. 51a

| CURRENT IN USE PRIORITIES (ANY) | | | | | | | | TX LL PRIORITY | | | | | | | |
|---------------------------------|---|---|---|---|---|---|---|----------------|---|---|---|---|---|---|---|
| | | | | | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| A | N | Y | T | X | S | E | T | 2 | 0 | 1 | 3 | 4 | 5 | 7 | 6 |

FIG. 51b

| CURRENT IN USE PRIORITIES (LL) | | | | | | | | REMAPPED TX PHY PRIORITIES | | | | | | | |
|--------------------------------|--|--|--|--|---|---|--|----------------------------|---|---|---|---|---|---|---|
| | | | | | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | | | | | 7 | | | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 7 |
| 0 | | | | | 6 | 7 | | 5 | 4 | 4 | 5 | 5 | 5 | 7 | 6 |

FIG.52a

| FIELD | LENGTH | MEANING |
|----------------|-----------|---|
| DA | 6 OCTETS | DESTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =4 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. SSLENGTH IS 6 FOR SSVERSION 0. |
| SSVERSION | 1 OCTET | =0 |
| LARQ_HDR DATA | 3 OCTETS | LARQ CONTROL HEADER DATA WITH LARQ_CTL BIT=1,LARQ_NACK=0. |
| NEXT ETHERTYPE | 2 OCTETS | =0 |
| PAD | 38 OCTETS | |
| FCS | 4 OCTETS | FRAME CHECK SEQUENCE |

FIG.52b

| FIELD | LENGTH | MEANING |
|----------------|-----------|---|
| DA | 6 OCTETS | DESTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =4 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. SSLENGTH IS 12 FOR NACK FRAMES WITH SSVERSION 0. |
| SSVERSION | 1 OCTET | =0 |
| LARQ_HDR DATE | 3 OCTETS | LARQ CONTROL HEADER DATA WITH LARQ_CTL BIT=1,LARQ_NACK=1..7. |
| NACK_DA | 6 OCTETS | ORIGINAL DESTINATION ADDRESS |
| NEXT ETHERTYPE | 2 OCTETS | =0 |
| PAD | 32 OCTETS | |
| FCS | 4 OCTETS | FRAME CHECK SEQUENCE |

FIG.52c

| FIELD | LENGTH | MEANING |
|----------------|---------------|---|
| DA | 6 OCTETS | DESTINATION ADDRESS (FROM ORIGINAL ETHERNET PDU) |
| SA | 6 OCTETS | SOURCE ADDRESS (FROM ORIGINAL ETHERNET PDU) |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =4 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. SSLENGTH IS 6 FOR SSVERSION 0.=6 |
| SSVERSION | 1 OCTET | =0 |
| LARQ_HDR DATA | 3 OCTETS | LARQ ENCAPSULATION HEADER DATA (WITH LARQ_CTL BIT=0) |
| NEXT ETHERTYPE | 2 OCTETS | FROM ORIGINAL ETHERNET PDU |
| PAYOUT | MIN 46 OCTETS | FROM ORIGINAL ETHERNET PDU PAYLOAD |
| FCS | 4 OCTETS | FRAME CHECK SEQUENCE |

FIG.52d

| OCTET | FIELD | LENGTH | MEANING |
|-------------|---------------|--------|---|
| FLAGS0 | LARQ_MULT | 1 BIT | MULTIPLE RETRANSMISSION FLAG. 0 IN THE ORIGINAL TRANSMISSION OF A DATA FRAME. FOR RETRANSMITTED FRAMES (LARQ_RTX=1), SET TO THE VALUE OF LARQ_MULT IN THE NACK FRAME THAT CAUSED THE RETRANSMISSION. THIS CAN BE USED BY RECEIVERS TO MEASURE THE ROUND-TRIP TIMES ASSOCIATED WITH THE MISS/NACK/RECEIVE-RTX PROCESS. |
| | LARQ_RTX | 1 BIT | 0 FOR FIRST TRANSMISSION OF A FRAME, 1 IF FRAME IS RETRANSMITTED. STATIONS NOT IMPLEMENTING LARQ SHALL DROP ANY DATA FRAME IF THIS BIT IS 1. |
| | LARQ_NORTX | 1 BIT | 0 IF IMPLEMENTATION SUPPORTS RETRANSMISSION, 1 IF ONLY PRIORITY IS MEANINGFUL. MAY BE USED ON A PERCHANNEL BASIS. |
| | LARQ_NEWSSEQ | 1 BIT | 1 IF THE SEQUENCE NUMBER SPACE FOR THE CHANNEL HAS BEEN RESET, AND OLDER SEQUENCE NUMBERS SHOULD NOT BE NACKED, 0 OTHERWISE. |
| | LARQ_CTL | 1 BIT | "0" WHEN IN ENCAPSULATION FORMAT |
| FLAGS1_SEQ0 | PRIORITY | 3 BITS | LINK LAYER PRIORITY OF THIS FRAME |
| | RESERVED | 4 BITS | RESERVED, SHALL BE 0 |
| | LARQ_SEQ_HIGH | 4 BITS | HIGH 4 BITS OF SEQUENCE NUMBER |
| SEQ1 | LARQ_SEQ_LOW | 8 BITS | LOW 8 BITS OF SEQUENCE NUMBER |

FIG.52e

| OCTET | FIELD | LENGTH | MEANING |
|-------------|---------------|--------|---|
| FLAGS0 | LARQ_MULT | 1 BIT | MULTIPLE RETRANSMISSION FLAG. 0 IN THE FIRST NACK SENT FOR A GIVEN SEQUENCE NUMBER, 1 IN ALL RETRANSMITTED NACKS. |
| | LARQ_NACK | 3 BITS | NACK COUNT IF 0 IN A LARQ CONTROL FRAME, THEN THIS IS A REMINDER. |
| | LARQ_CTL | 1 BIT | SET TO 1 FOR LARQ CONTROL HEADER DATA FORMAT |
| | PRIORITY | 3 BITS | LINK LAYER PRIORITY OF THIS FRAME |
| FLAGS1_SEQ0 | RESERVED | 4 BITS | RESERVED, SHALL BE 0 |
| | LARQ_SEQ_HIGH | 4 BITS | HIGH 4 BITS OF SEQUENCE NUMBER |
| SEQ1 | LARQ_SEQ_LOW | 8 BITS | LOW 8 BITS OF SEQUENCE NUMBER |

FIG.52f.1

| | |
|--------------------------|---|
| CONTROL FRAME | A FRAME GENERATED BY A LARQ PROTOCOL MODULE THAT CONTAINS ONLY A LARQ PROTOCOL HEADER AS ITS PAYLOAD. |
| CURRENT SEQUENCE NUMBER | THE MOST RECENTLY RECEIVED NEW SEQUENCE NUMBER FOR A CHANNEL. |
| DATA FRAME | ANY STANDARD ETHERNET FRAME FROM HIGHER (THAN LARQ) PROTOCOL LAYERS. A LARQ-ENABLED STATION ENCAPSULATES THE ORIGINAL PAYLOAD OF AN ETHERNET FRAME BY INSERTING A LARQ HEADER (SHORTER FORM CONTROL HEADER WITH LARQ_HDR DATA) BETWEEN THE SOURCE ADDRESS AND THE REMAINDER OF THE FRAME BEFORE THE FRAME IS PASSED DOWN TO THE DRIVER FOR TRANSMISSION ON THE NETWORK. |
| FORGET TIMER | AN IMPLEMENTATION DEPENDENT MECHANISM TO ALLOW A RECEIVER TO RESET THE SEQUENCE NUMBER SPACE OF A CHANNEL WHEN A RECEIVED SEQUENCE NUMBER IS NOT THE NEXT EXPECTED (CURRENT SEQUENCE NUMBER+1). ONE SECOND IS A SUGGESTED DEFAULT VALUE. |
| HOLD TIMER, LOST TIMER | AN IMPLEMENTATION DEPENDENT TIMING MECHANISM THAT LIMITS THE TIME A RECEIVER WILL HOLD ONTO A RECEIVED FRAME WHILE WAITING FOR A MISSING FRAME TO BE RETRANSMITTED. CONCEPTUALLY, THERE IS ONE SUCH TIMER PER MISSING SEQUENCE NUMBER. THE TIMER INTERVAL IS MAXIMUM HOLD INTERVAL. |
| LOGICAL CHANNEL, CHANNEL | A FLOW OF FRAMES FROM A SENDER TO ONE OR MORE RECEIVERS ON A SINGLE NETWORK SEGMENT CONSISTING OF ALL THE FRAMES WITH A SINGLE COMBINATION OF DESTINATION ADDRESS, SOURCE ADDRESS, AND LINK LAYER PRIORITY. |
| NACK, NACK, NACK | AN INDICATION FROM A RECEIVER TO A SENDER REQUESTING RETRANSMISSION OF ONE OR MORE FRAMES. ALSO, THE ACTION OF PROVIDING SUCH AN INDICATION. E.G. "TO NACK A SEQUENCE NUMBER" MEANING TO SEND A NACK INDICATION. |
| NACK TIMER | AN IMPLEMENTATION DEPENDENT TIMING MECHANISM USED BY A RECEIVER TO RETRANSMIT NACKS FOR MISSING SEQUENCE NUMBERS. CONCEPTUALLY, THERE IS ONE SUCH TIMER PER MISSING SEQUENCE NUMBER PER LOGICAL CHANNEL. THE TIMER IS RESET EACH TIME A NACK IS SENT FOR A SEQUENCE NUMBER. THE TIMER INTERVAL IS NACK RETRANSMISSION INTERVAL. |
| NEW | A NEW SEQUENCE NUMBER IS ONE WHOSE DIFFERENCE FROM THE CURRENT SEQUENCE NUMBER FOR THE CHANNEL, MODULO THE SIZE OF THE SEQUENCE NUMBER SPACE AND CONSIDERED AS A SIGNED INTEGER, IS GREATER THAN 0. IN PARTICULAR, THE NUMBERS (CURRENT+1) THROUGH (CURRENT+2047). |
| OLD | AN OLD SEQUENCE NUMBER IS ONE WHOSE DIFFERENCE FROM THE CURRENT SEQUENCE NUMBER FOR THE CHANNEL, MODULO THE SIZE OF THE SEQUENCE NUMBER SPACE AND CONSIDERED AS A SIGNED INTEGER, IS LESS THAN OR EQUAL TO 0. IN PARTICULAR, THE NUMBERS (CURRENT-2048) THROUGH (CURRENT) ARE OLD. NOTE, HOWEVER, THAT MOST OF THE OLD SEQUENCE NUMBERS ARE ALSO OUT-OF-SEQUENCE. |

FIG.52f.2

| | |
|------------------|--|
| OUT OF SEQUENCE | ANY SEQUENCE NUMBER THAT FALLS OUTSIDE A REASONABLE RANGE, OLD OR NEW, OF THE CURRENT SEQUENCE NUMBER FOR A LOGICAL CHANNEL IS CONSIDERED OUT OF SEQUENCE. IT IS RECOMMENDED THAT PLUS OR MINUS TWICE THE VALUE OF MAXIMUMSAVELIMIT (DEFINED BELOW) BE USED AS THE "REASONABLE RANGE" WHEN CHECKING FOR OUT OF SEQUENCE. |
| RECEIVER | A STATION THAT RECEIVES FRAMES SENT ON A PARTICULAR CHANNEL. IF THE DESTINATION ADDRESS IS A UNICAST ADDRESS THERE IS AT MOST ONE RECEIVER. IF THE DESTINATION ADDRESS IS A GROUP ADDRESS (INCLUDING BROADCAST), THEN THERE MAY BE MANY RECEIVERS. |
| REMINDER | A CONTROL FRAME SENT BY THE CHANNEL SENDER WITH THE MOST RECENTLY USED SEQUENCE NUMBER FOR A CHANNEL WHICH HAS BEEN INACTIVE FOR REMINDER INTERVAL AFTER ITS MOST RECENT DATA FRAME. |
| REMINDER TIMER | AN IMPLEMENTATION DEPENDENT TIMING MECHANISM USED BY A SENDER TO GENERATE A REMINDER FRAME AFTER A PERIOD OF INACTIVITY FOR A CHANNEL. THE TIMER IS RESET EACH TIME A NEW DATA FRAME IS TRANSMITTED. CONCEPTUALLY, THERE IS ONE SUCH TIMER PER CHANNEL. THE TIMER INTERVAL IS REMINDER INTERVAL. |
| SAVE TIMER | AN IMPLEMENTATION DEPENDENT TIMING MECHANISM THAT LIMITS THE TIME A SENDER WILL SAVE A FRAME WAITING FOR RETRANSMISSION REQUESTS. THE TIMER INTERVAL IS MAXIMUM SAVE INTERVAL. |
| SENDER | THE SENDING STATION FOR A CHANNEL, USUALLY THE STATION OWNING THE SOURCE MAC ADDRESS. |
| SEQUENCE NUMBERS | SEQUENCE NUMBERS ARE MAINTAINED SEPARATELY FOR EACH LOGICAL CHANNEL BY THE SENDER. |

FIG.53

| | |
|---------------------------------|---|
| SEND SEQUENCE NUMBER | THE SEQUENCE NUMBER OF THE MOST RECENTLY TRANSMITTED DATA FRAME. |
| REMINDER TIMER INTERVAL | A FIXED INTERVAL. THE DEFAULT IS 50 MS. LOWER VALUES WILL INCREASE THE OVERHEAD OF REMINDERS ON NETWORK LOAD, WHILE HIGHER VALUES INCREASE THE LATENCY FOR END-OF-SEQUENCE FRAMES REQUIRING RETRANSMISSION. IMPLEMENTATIONS SHOULD NOT USE VALUES OUTSIDE OF THE RANGE 25–75 MS, BASED ON 150 MS MAXIMUM SAVE AND HOLD TIMES. |
| MINIMUM RETRANSMISSION INTERVAL | AN INTERVAL USED TO PREVENT TOO-FREQUENT RETRANSMISSIONS OF A SINGLE FRAME. MOST IMPORTANT FOR MULTICAST CHANNELS. THE DEFAULT IS 10 MS. |
| MAXIMUM SAVE LIMIT | THE MAXIMUM NUMBER OF FRAMES THAT WILL BE SAVED FOR A SINGLE LOGICAL CHANNEL. THIS IMPLEMENTATION DEPENDENT, AND VARIES WITH THE MAXIMUM FRAME RATE THE SENDER IS EXPECTED TO SUPPORT. VALUES OF 100 OR MORE CAN BE USEFUL FOR HIGH-SPEED APPLICATIONS SUCH AS VIDEO. |
| MAXIMUM SAVE INTERVAL | THE MAXIMUM TIME THAT THE SENDER WILL NORMALLY SAVE A FRAME FOR POSSIBLE RETRANSMISSION. THE DEFAULT IS 150 MS. |

FIG.54

| | |
|--------------------------------|--|
| CURRENT SEQUENCE NUMBER | THE MOST RECENT SEQUENCE NUMBER RECEIVED IN A LARQ HEADER FOR THE CHANNEL, WHETHER IN A DATA FRAME OR A REMINDER CONTROL FRAME. |
| OLDEST MISSING SEQUENCE NUMBER | THE OLDEST SEQUENCE NUMBER FOR A FRAME NOT YET RECEIVED WHICH HAS NOT BEEN DECLARED LOST. |
| MAXIMUM HOLD INTERVAL | THE LONGEST INTERVAL THAT A FRAME WILL BE HELD AWAITING AN EARLIER MISSING FRAME. THE DEFAULT IS TO USE THE SAME VALUE AS MAXIMUM SAVE INTERVAL, WHICH HAS A DEFAULT OF 150 MS. |
| MAXIMUM RECEIVE LIMIT | THE MAXIMUM NUMBER OF FRAMES THAT A RECEIVER WILL BUFFER WHILE AWAITING AN EARLIER MISSING FRAME. THE DEFAULT SHOULD NORMALLY BE THE SAME AS THE MAXIMUM SAVE LIMIT. |
| NACK RETRANSMISSION INTERVAL | THE INTERVAL AFTER WHICH A RECEIVER WILL RETRANSMIT A NACK CONTROL FRAME FOR A MISSING SEQUENCE NUMBER, WITH THE EXPECTATION THAT EARLIER NACK CONTROL FRAMES OR DATA FRAME RETRANSMISSIONS WERE LOST. THE DEFAULT FOR FIXED IMPLEMENTATIONS IS 20 MS. |

FIG.55a

| FIELD | LENGTH | MEANING |
|----------------|--------------|--|
| DA | 6 OCTETS | DESTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| SSTYPE | 1 OCTET | =5 |
| SSLENGTH | 1 OCTET | NUMBER OF ADDITIONAL OCTETS IN THE CONTROL HEADER, STARTING WITH THE SSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. SSLENGTH SHALL BE \geq 6 FOR SSVERSION 0. |
| SSVERSION | 1 OCTET | =0 |
| VENDOR OUI | 3 OCTETS | AN IEEE ASSIGNED ORGANIZATIONALLY UNIQUE IDENTIFIER |
| CONTROL DATA | 0-249 OCTETS | VENDOR SPECIFIC CONTROL DATA |
| NEXT ETHERTYPE | 2 OCTETS | = NEXT ETHERTYPE IF AN ENCAPSULATION FORMAT, OR 0 IF NO ENCAPSULATED FRAME |
| PAD | 0-38 OCTETS | ANY VALUE OCTET |
| FCS | 4 OCTETS | |

FIG.55b

| FIELD | LENGTH | MEANING |
|----------------|----------------|---|
| DA | 6 OCTETS | DESTINATION ADDRESS |
| SA | 6 OCTETS | SOURCE ADDRESS |
| ETHERTYPE | 2 OCTETS | 0x886c (LINK CONTROL FRAME) |
| LSTYPE | 2 OCTETS | =32769 |
| LSLENGTH | 2 OCTETS | NUMBER OF ADDITIONAL OCTETS STARTING WITH THE LSVERSION FIELD AND ENDING WITH THE SECOND(LAST) OCTET OF THE NEXT ETHERTYPE FIELD. LSLENGTH SHALL BE >6 FOR LSVERSION 0. |
| LSVERSION | 1 OCTET | =0 |
| VENDOR OUI | 3 OCTETS | AN IEEE ASSIGNED ORGANIZATIONALLY UNIQUE IDENTIFIER |
| CONTROL DATA | 1-65531 OCTETS | VENDOR SPECIFIC DATA |
| NEXT ETHERTYPE | 2 OCTETS | = NEXT ETHERTYPE IF AN ENCAPSULATION FORMAT, OR 0 IF NO ENCAPSULATED FRAME |
| PAD | 40-0 OCTETS | IF NEEDED TO MAKE MINIMUM SIZE FRAME. SHOULD BE ZERO. |
| FCS | 4 OCTETS | |

FIG. 56

| CARRIER SENSE STATE | OUTPUT EVENTS |
|---------------------|--|
| INIT | ENERGY<=0. ONLY START-OF-PREAMBLE EVENTS CHECKED. |
| IDLE | ONLY START-OF-PREAMBLE EVENTS CHECKED. |
| BUSY | ONLY END-OF-PREAMBLE EVENTS CHECKED. |
| TRANSMIT | ONLY START-OF-PREAMBLE EVENTS CHECKED(COLLISION DETECTION) |

FIG. 57

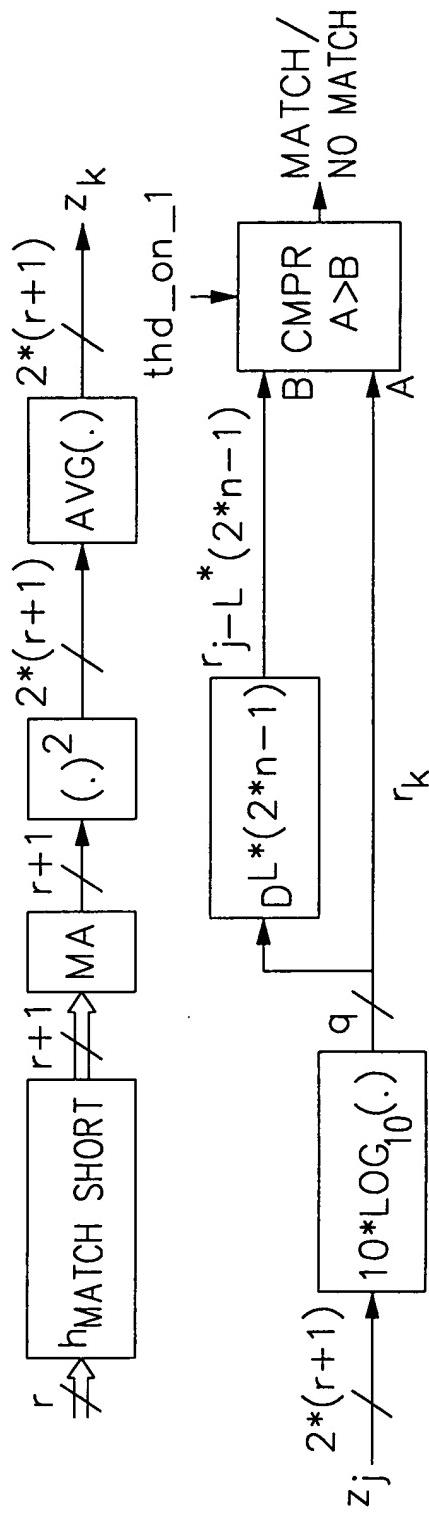


FIG. 58

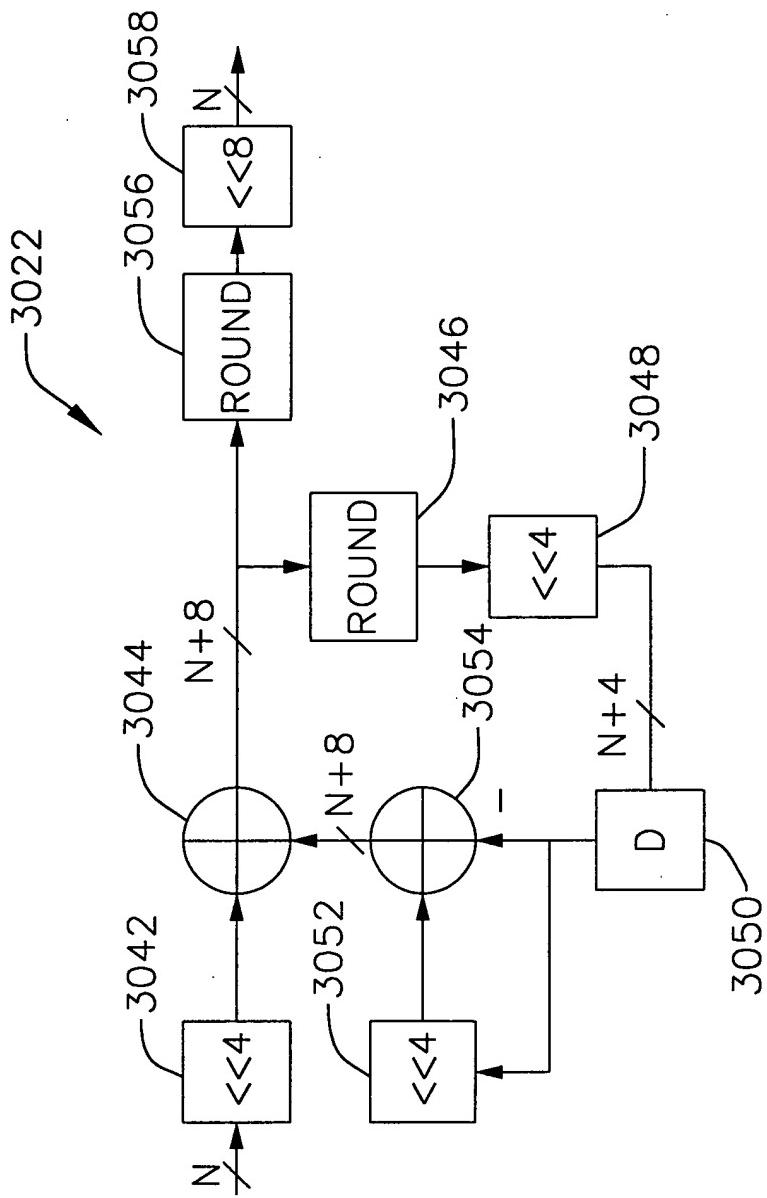


FIG. 59 — 3010

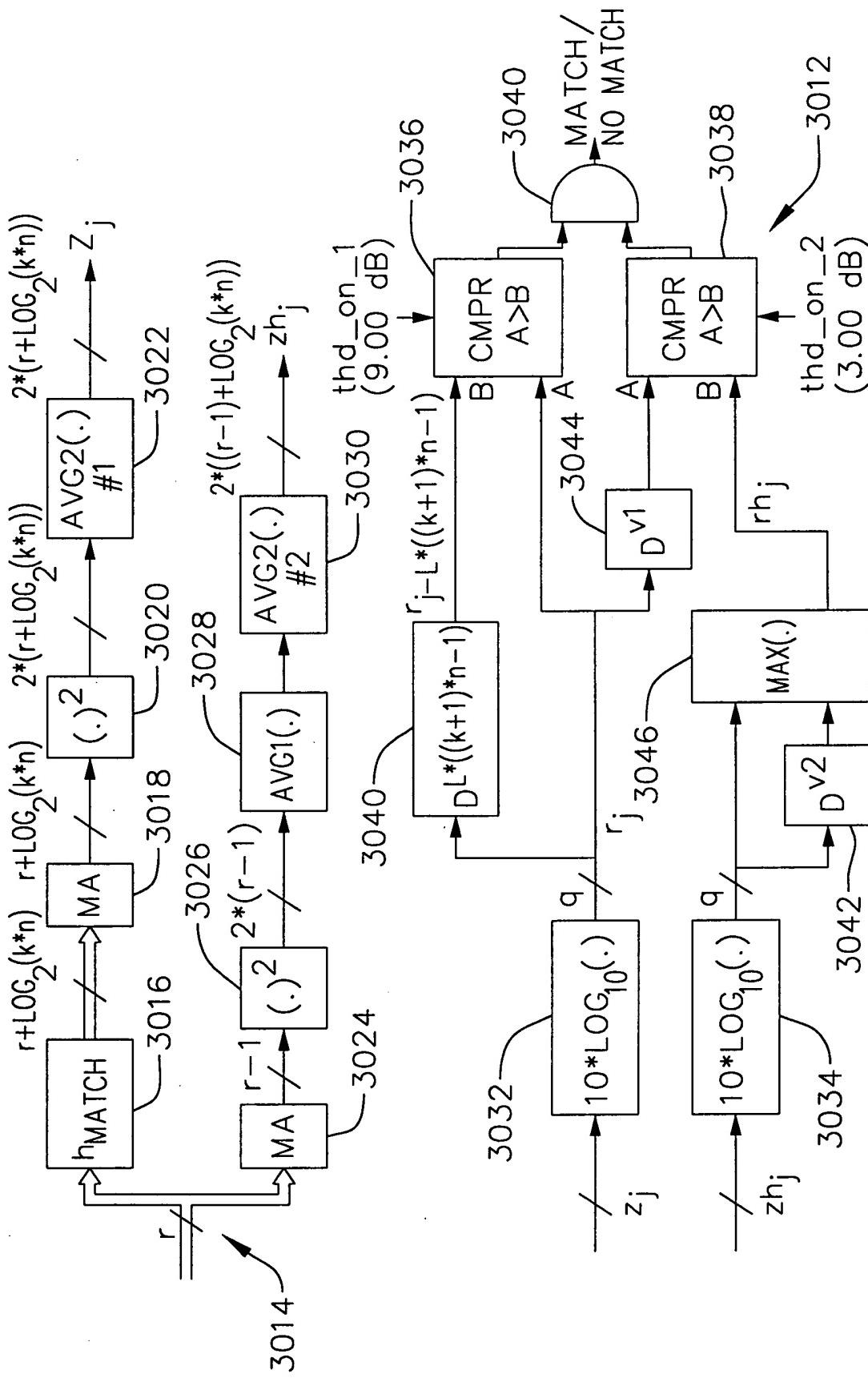


FIG. 60

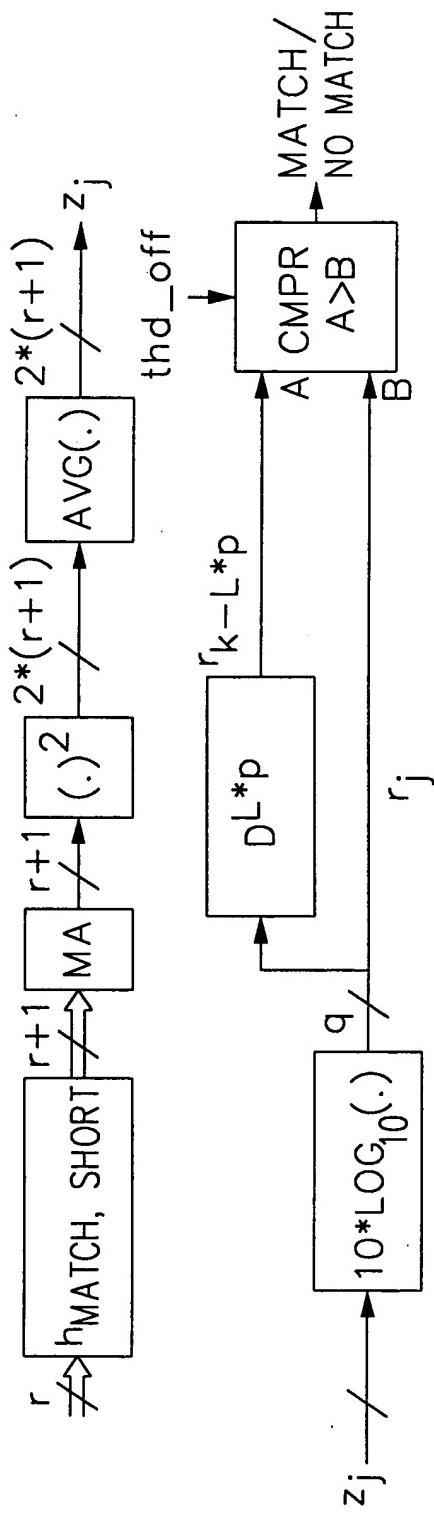


FIG. 61

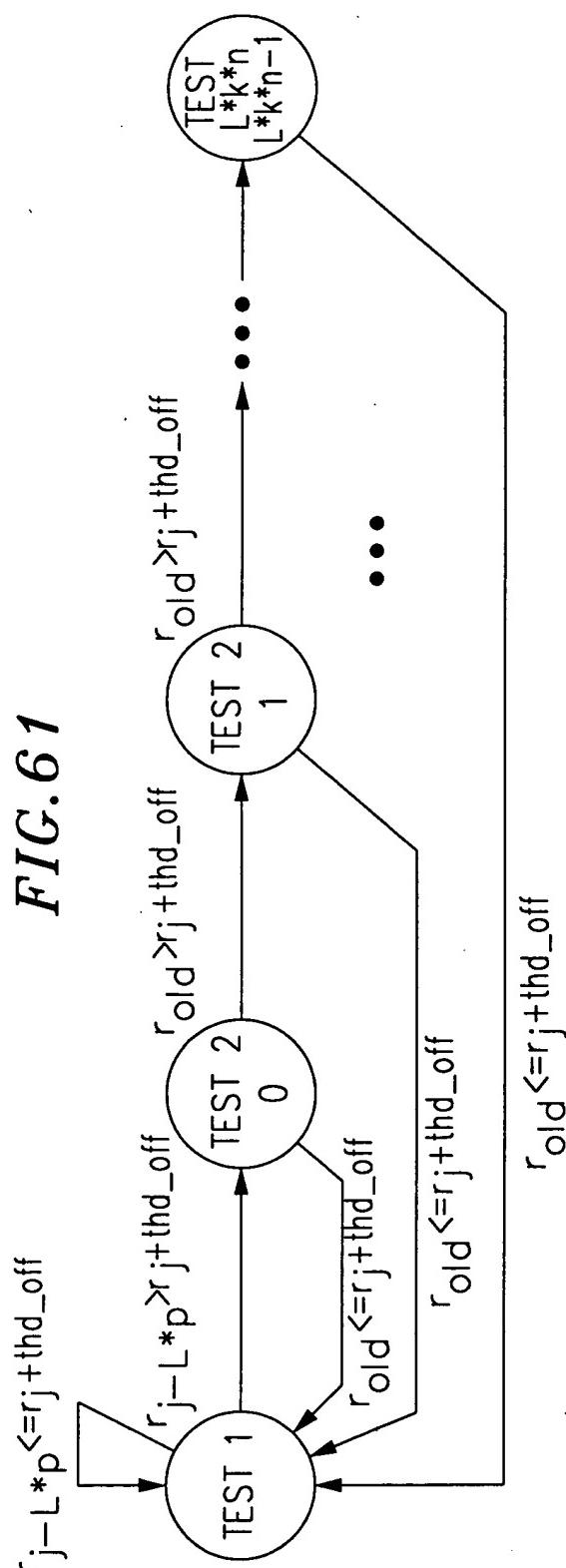


FIG. 62a

| TABLE INDEX | TABLE VALUE (dB) |
|-------------|---------------------|
| 0 | 0.00 |
| 1 | 3.00 |
| 2 | 6.00 |
| 3 | 9.00 |
| 4 | 12.00 |
| 5 | 15.00 |
| 6 | 18.00 |
| 7 | 21.00 |
| 8 | 24.00 |
| 9 | 27.00 |
| 10 | 30.00 |
| 11 | 33.00 |
| 12 | 36.00 |
| 13 | 39.25 |
| 14 | 42.25 |
| 15 | 45.25 |
| 16 | 48.25 |
| 17 | 51.25 |
| 18 | 54.25 |
| 19 | 57.25 |
| 20 | 60.25 |
| 21 | 63.25 |
| 22 | 66.25 |
| 23 | 69.25 |
| 24 | 72.25 |
| 25 | 75.25 |
| 26 | 78.25 |
| 27 | 81.25 |
| 28 | 84.25 |
| 29 | 87.25 |
| 30 | 90.25 |
| 31 | 93.25 |

FIG. 62b

| TABLE INDEX | TABLE VALUE (dB) |
|-------------|---------------------|
| 0 | 0.00 |
| 1 | 0.25 |
| 2 | 0.25 |
| 3 | 0.50 |
| 4 | 0.50 |
| 5 | 0.75 |
| 6 | 0.75 |
| 7 | 0.75 |
| 8 | 1.00 |
| 9 | 1.00 |
| 10 | 1.25 |
| 11 | 1.25 |
| 12 | 1.50 |
| 13 | 1.50 |
| 14 | 1.50 |
| 15 | 1.75 |
| 16 | 1.75 |
| 17 | 1.75 |
| 18 | 2.00 |
| 19 | 2.00 |
| 20 | 2.00 |
| 21 | 2.25 |
| 22 | 2.25 |
| 23 | 2.25 |
| 24 | 2.50 |
| 25 | 2.50 |
| 26 | 2.50 |
| 27 | 2.75 |
| 28 | 2.75 |
| 29 | 2.75 |
| 30 | 2.75 |
| 31 | 3.00 |

FIG. 63a

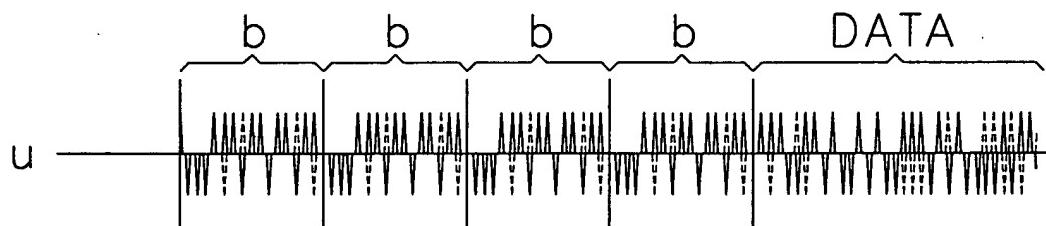


FIG. 63b



FIG. 63c

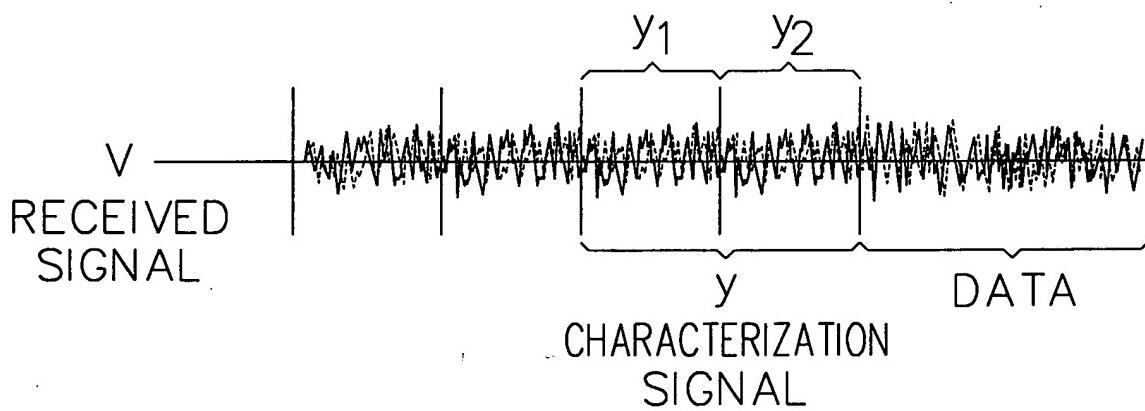


FIG. 64

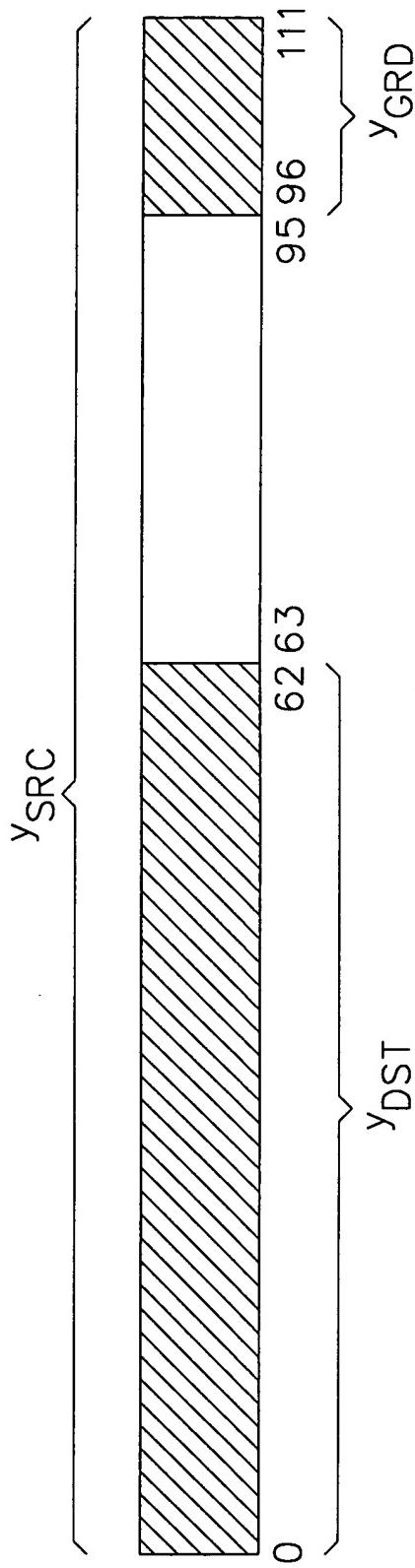


FIG. 65

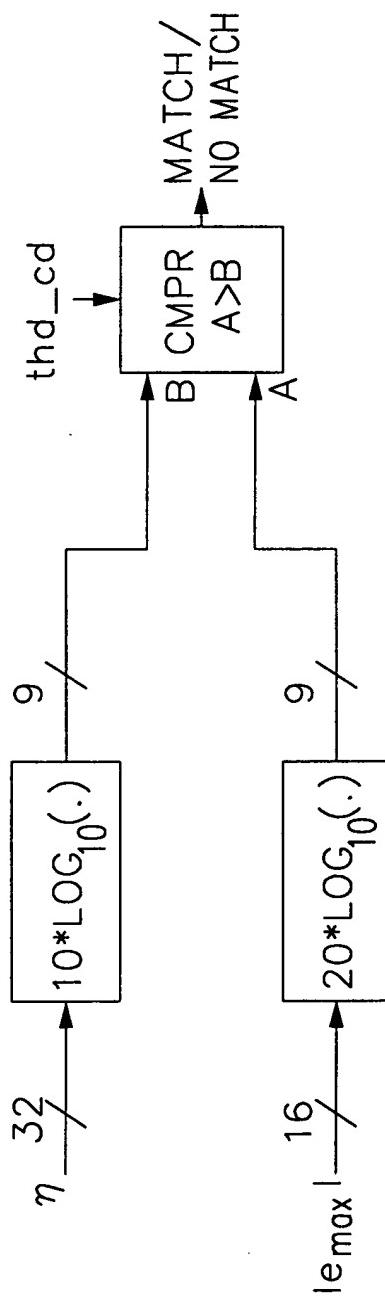


FIG. 66a

| TABLE INDEX | TABLE VALUE |
|-------------|-------------|
| 0 | 0.00 |
| 1 | 6.00 |
| 2 | 12.00 |
| 3 | 18.00 |
| 4 | 24.00 |
| 5 | 30.00 |
| 6 | 36.00 |
| 7 | 42.25 |
| 8 | 48.25 |
| 9 | 54.25 |
| 10 | 60.25 |
| 11 | 66.25 |
| 12 | 72.25 |
| 13 | 78.25 |
| 14 | 84.25 |
| 15 | 90.25 |

FIG. 66b

| TABLE INDEX | TABLE VALUE |
|-------------|-------------|
| 0 | 0.00 |
| 1 | 0.50 |
| 2 | 1.00 |
| 3 | 1.50 |
| 4 | 2.00 |
| 5 | 2.25 |
| 6 | 2.75 |
| 7 | 3.25 |
| 8 | 3.50 |
| 9 | 4.00 |
| 10 | 4.25 |
| 11 | 4.50 |
| 12 | 4.75 |
| 13 | 5.25 |
| 14 | 5.50 |
| 15 | 5.75 |

FIG. 67

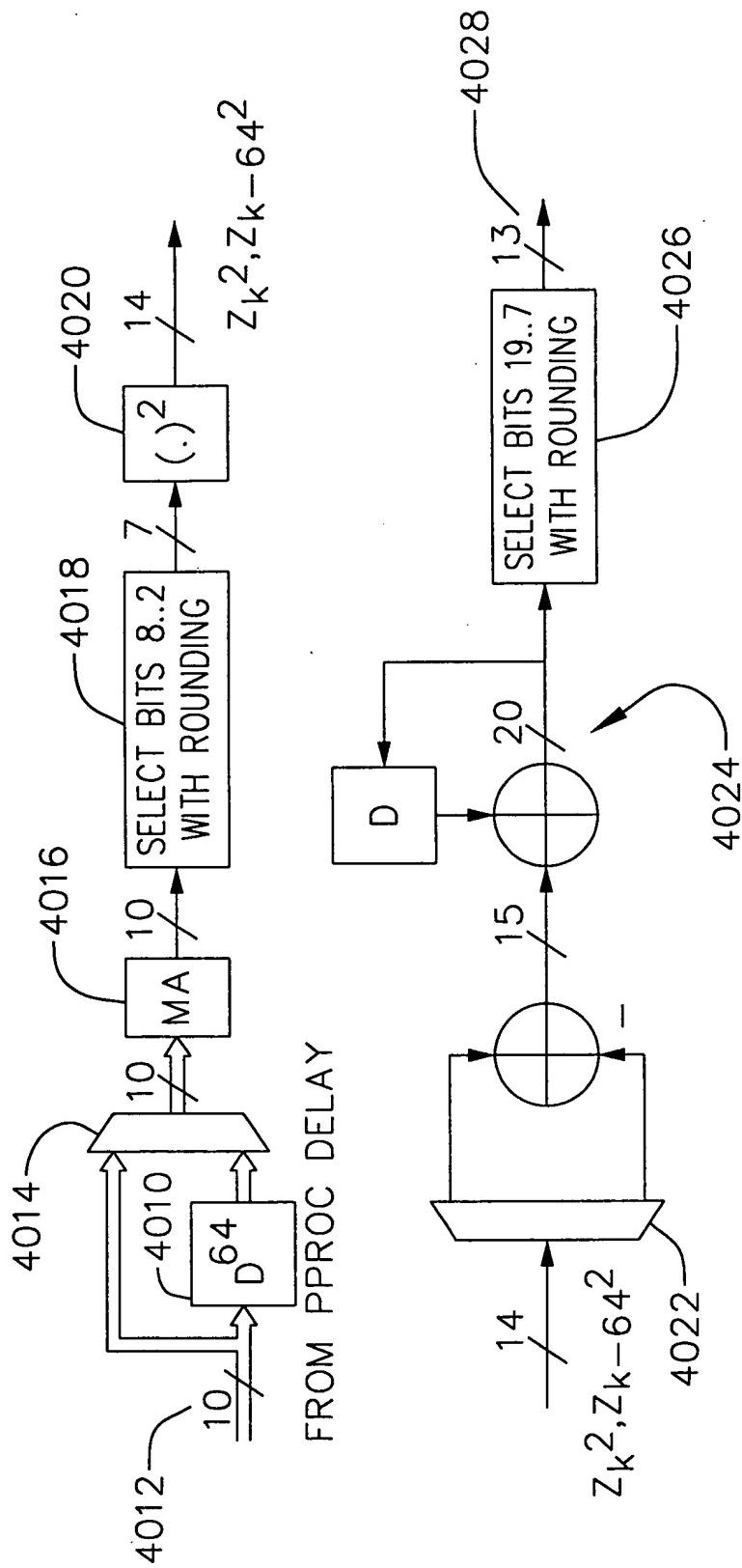


FIG. 68

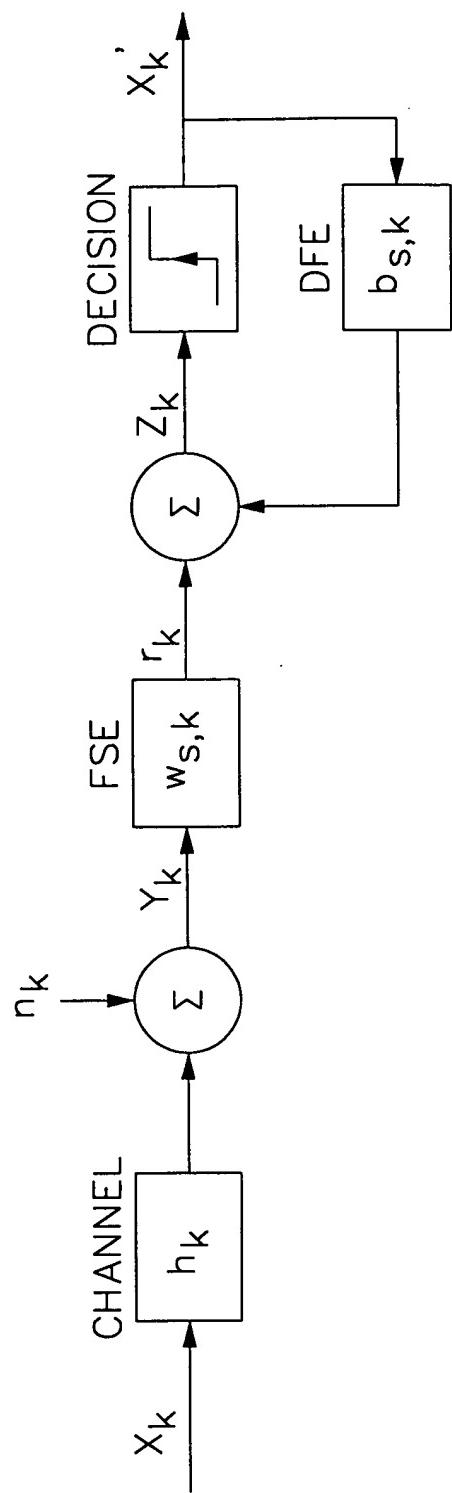


FIG. 69

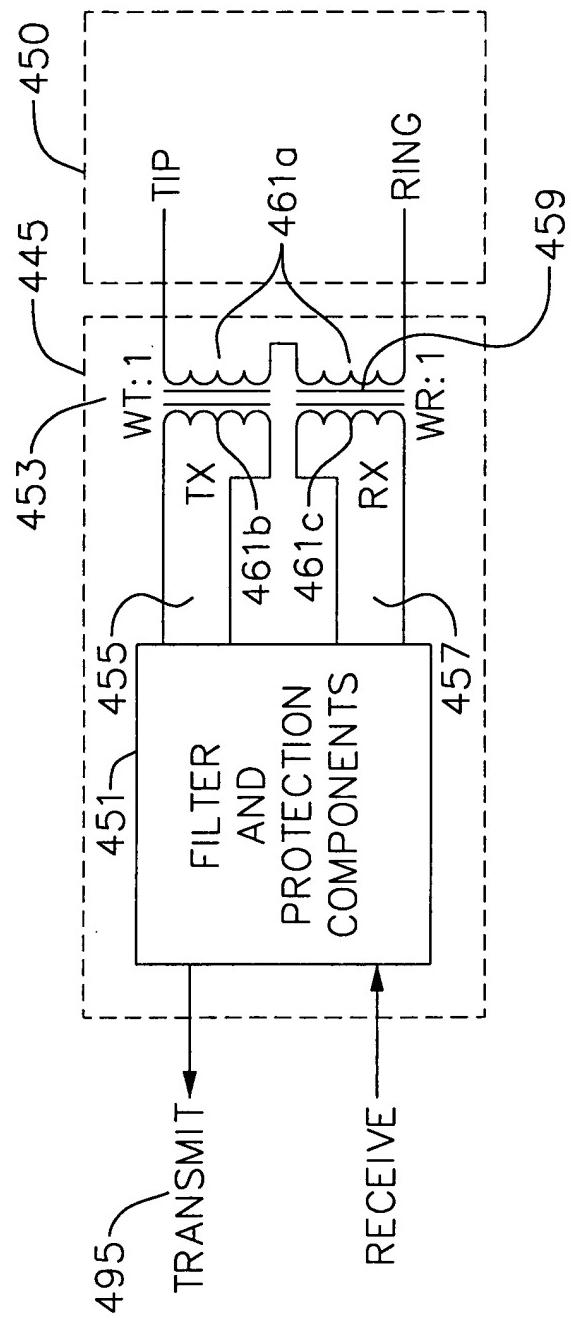
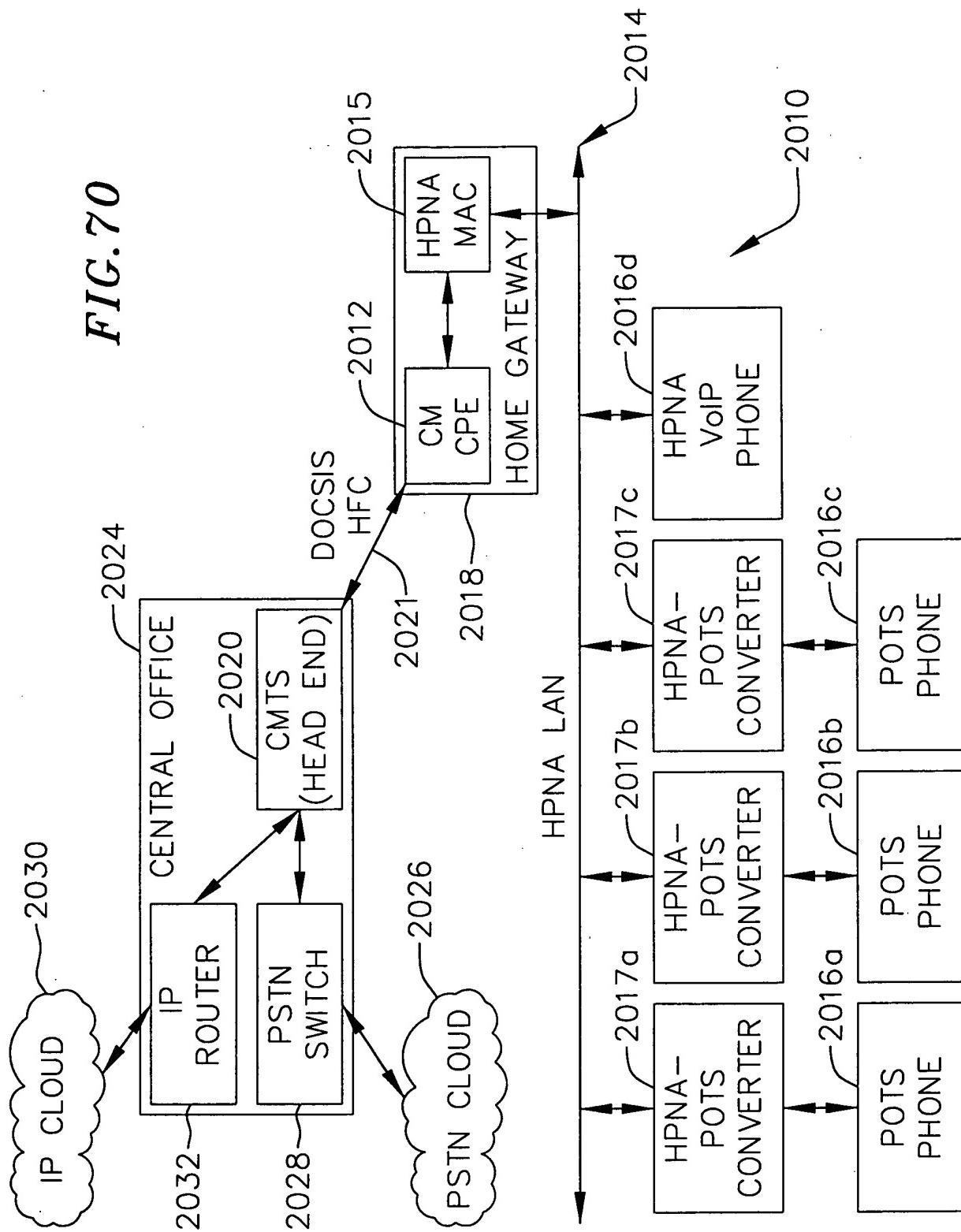


FIG. 70



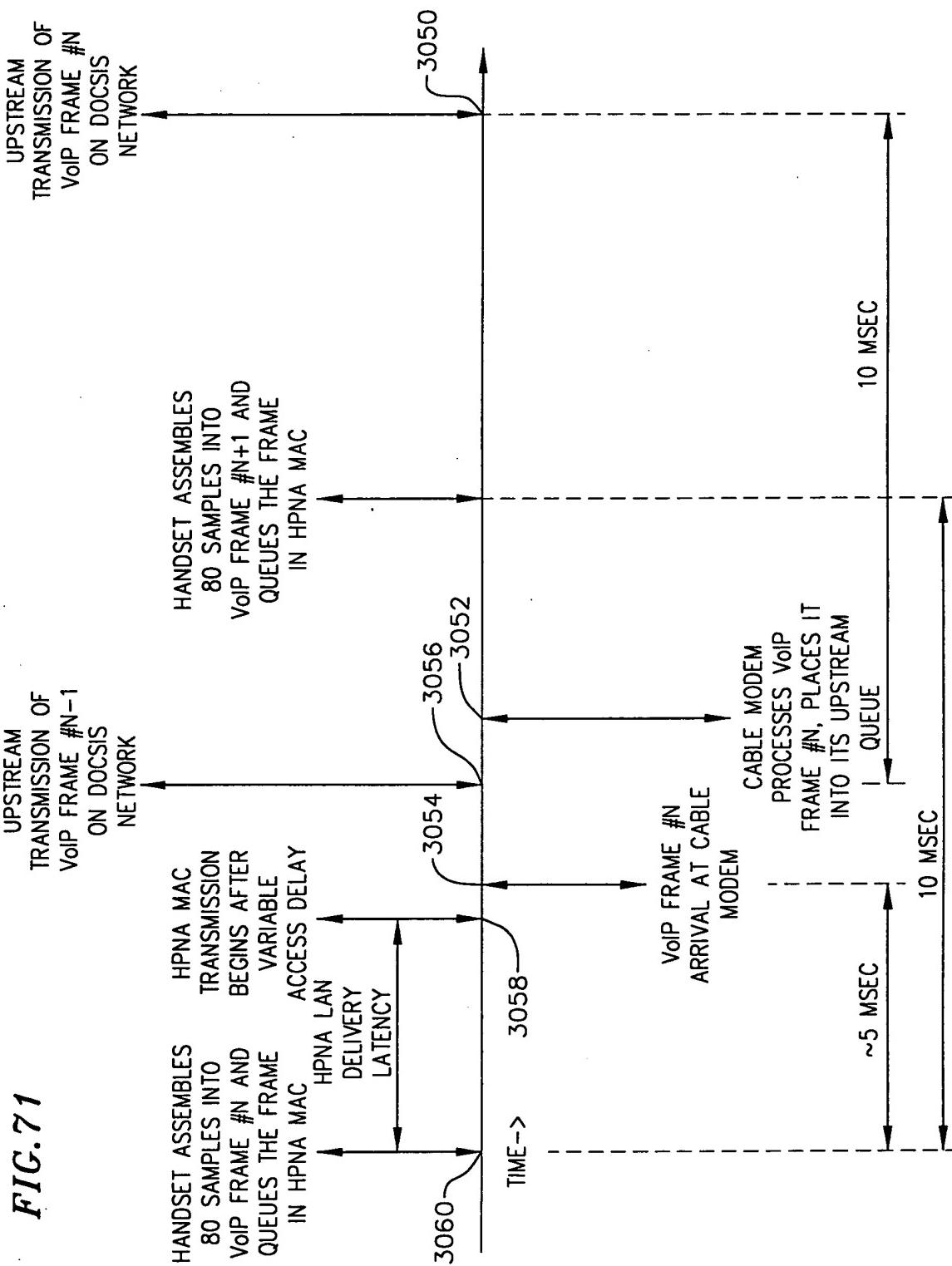


FIG. 72a

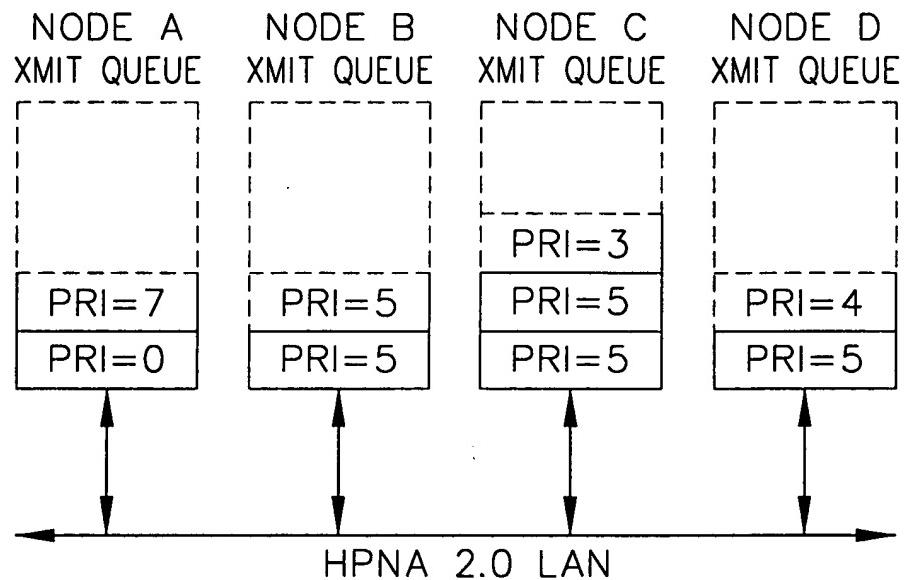


FIG. 72b

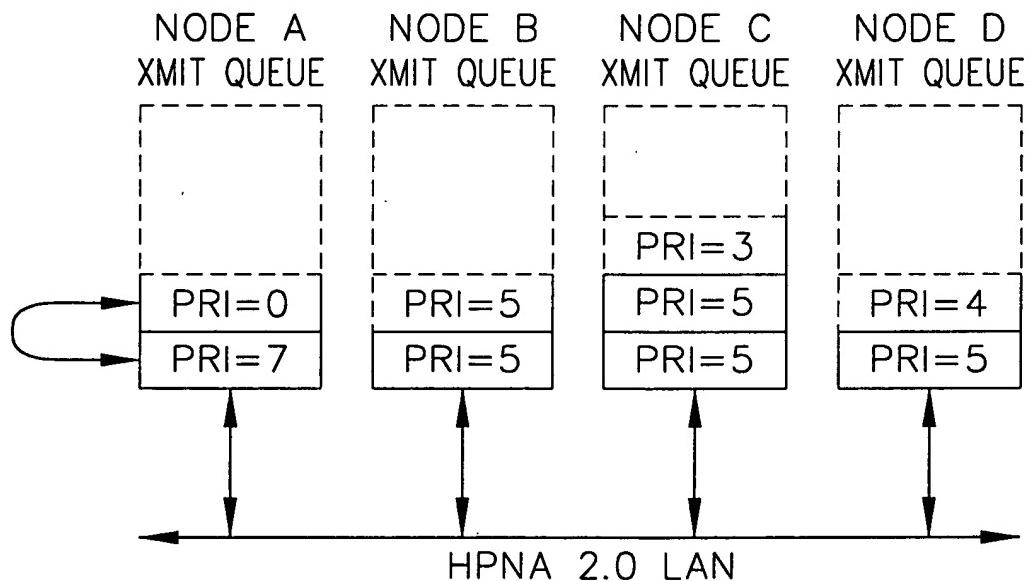


FIG. 73

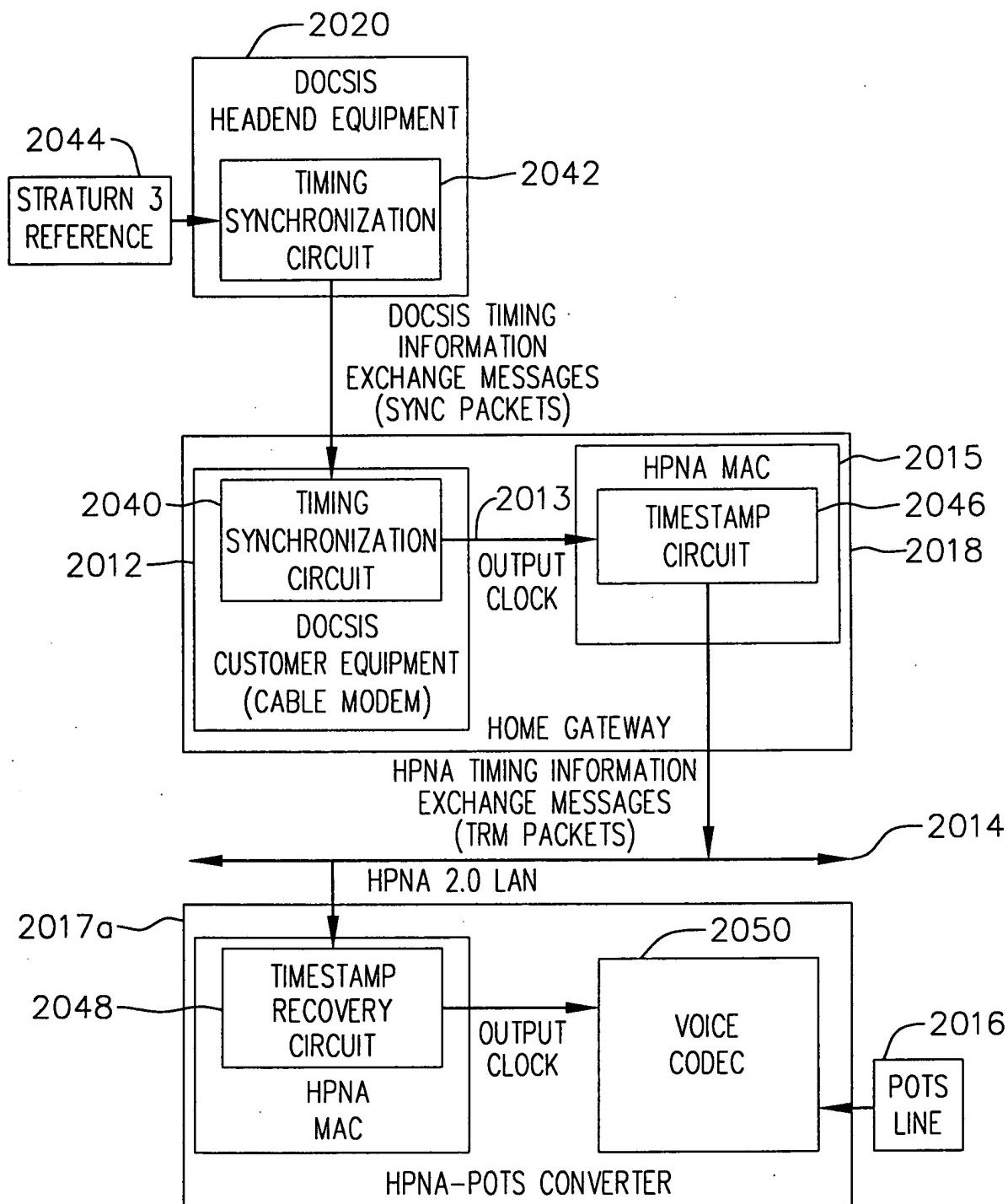


FIG. 74

| PARAMTER | UPSTREAM | | | DOWNSTREAM | | |
|----------------------|-------------|----------|----------|-------------|----------|----------|
| | "10E-6 CASE | 91% CASE | 90% CASE | "10E-6 CASE | 91% CASE | 90% CASE |
| ACCESS DELAY | 3.1 | 1.3 | 1.3 | 3.1 | 1.3 | 1.3 |
| COLLISION RESOLUTION | 2.7 | 2.7 | 0.8 | 2.7 | 2.7 | 0.8 |
| 3 UP, 1 DOWN | 2.1 | 1.0 | 1.0 | 2.1 | 1.0 | 1.0 |
| LAST UP | 0.5 | 0.3 | 0.3 | 0.5 | 0.3 | 0.3 |
| COLLISION RESOLUTION | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 3 UP, 1 DOWN | 2.1 | 1.0 | 1.0 | 2.1 | 1.0 | 1.0 |
| LAST UP | 0.5 | 0.3 | 0.3 | 0.5 | 0.3 | 0.3 |
| 3 DOWN | | | | 1.5 | 0.8 | 0.8 |
| 3 DOWN | | | | 1.5 | 0.8 | 0.8 |
| TOTAL LATENCY | 11.8 | 7.4 | 5.5 | 14.9 | 8.9 | 7.1 |

10E-6 CASE IS 10E-6 CRA ONCE OF TWO TRIES IN HOMES WITH MAXIMUM 4MBITS/SEC RAW RATE

91% CASE IS 10E-6 CRA ONCE OF TWO TRIES IN HOMES WITH MINIMUM 10MBITS/SEC RAW RATE

90% CASE IS 10E-1 CRA TWICE IN TWO TRIES IN HOMES WITH MINIMUM 10MBITS/SEC RAW RATE

VALUES IN THE TABLE ABOVE ARE IN MILLISECONDS.

| OVERHEADS: | | | | | | LINEAR | 5 | 5 | 5 |
|------------|-------|-------|-------|-------|-------|------------|------------|------------|-------|
| | | | | | | PCM | NODES | NODES | NODES |
| IFG | PER | FRAME | LARQ | RTP_H | FRAME | CRA | CRA | CRA | |
| COLL | | HDR | HDR | DR | SIZE | 10E-6 | 10E-1 | FIXED | |
| 0.018 | 0.206 | 0.07 | 8 | 40 | 160 | 13 | 4 | 2 | |
| MSEC | MSEC | MSEC | BYTES | BYTES | BYTES | COLLISIONS | COLLISIONS | COLLISIONS | |

FRAME HEADER INCLUDES PREAMBLE, FC, DA, SA, T/L, EOF

FIG. 75

| PARAMTER | UPSTREAM | | | DOWNSTREAM | | |
|----------------------|----------|------|------|------------|------|------|
| | "10E-6 | 91% | 90% | "10E-6 | 91% | 90% |
| CASE | CASE | CASE | CASE | CASE | CASE | CASE |
| ACCESS DELAY | 3.1 | 1.3 | 1.3 | 3.1 | 1.3 | 1.3 |
| COLLISION RESOLUTION | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| 3 UP, 1 DOWN | 1.4 | 0.8 | 0.8 | 1.4 | 0.8 | 0.8 |
| LAST UP | 0.5 | 0.3 | 0.3 | 0.5 | 0.3 | 0.3 |
| COLLISION RESOLUTION | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 UP, 1 DOWN | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| LAST UP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 DOWN | | | | 1.1 | 0.6 | 0.6 |
| 3 DOWN | | | | 0.0 | 0.0 | 0.0 |
| TOTAL LATENCY | 5.5 | 2.7 | 2.7 | 6.5 | 3.3 | 3.3 |

Fig. 16

| <u>Field</u> | <u>Length</u> | <u>Meaning</u> |
|--------------|---------------|---|
| DA | 6 octets | Destination Address |
| SA | 6 octets | Source Address |
| Ethertype | 2 octets | (TBD) = VOHN Link Control Frame - new IEEE assignment |
| Type | 2 octets | 1 = Timestamp Sync Message |
| Length | 2 octets | = 4 |
| Version | 2 octets | = 0 |
| SeqNum | 2 octets | Timestamp Sync Message Sequence Number |
| Pad | | Any value octet |
| FCS | 4 octets | Frame Check Sequence |

Fig. 77(1)

| <u>Field</u> | <u>Length</u> <u>h</u> | <u>Meaning</u> |
|--------------|---------------------------|--|
| DA | 6 octets | Destination Address |
| SA | 6 octets | Source Address |
| EtherType | 2 octets | (TBD) = VOHN Link Control Frame - new IEEE assignment |
| Type | 2 octets | 2 = Timestamp Report Message |
| Length | 2 octets | Number of additional octets in the signaling frame, starting with Version field and ending with the last octet of the Data Payload field. Minimum is 2. |
| Version | 2 octets | = 0 |
| TSMSeqNum | 2 octets | Sequence number of TSM to which the Timestamp in this message is applicable. |
| Timestamp | 4 octets | Timestamp of a previously transmitted Timestamp Report Message, corresponding to TSMSeqNum. |
| Frequency | 2 octets | Resolution of the timestamp and Gtimestamp fields, in ticks/1.000ms. For example, value 32768 corresponds to one clock tick at 32.768Mhz, in which the LSBit of the Timestamp corresponds to a time of 0.030517578125usec. The Timestamp will rollover every 131 seconds = 2.2 minutes |
| NumGrants | 2 octets | Number of Grant Timestamps specified in the payload of this control message. NumGrants may be zero. Each grant timestamp is accompanied by a Line ID and Call ID field. Including the Grant Timestamp, the total for each grant timestamp is 8 bytes. |

Fig. 77(2)

| | | |
|----------------|----------|---|
| Line ID | 2 octets | Identifier of the Line termination associated with the immediately following GTimestamp. |
| Call ID | 2 octets | Identifier of the call instance on the Line termination associated with the immediately following GTimestamp. |
| GrantTimestamp | 4 octets | Grant Timestamp corresponding to the immediately preceding Line ID. This is the time at which the Proxy Gateway wishes to receive a future constant bit rate service flow packet in order to minimize delivery latency to subsequent delivery to a synchronous network. The time value corresponds to the time at the timing master. Additional packets for the identified service flow are expected to arrive at periodic intervals measured from this time. |
| ... | | additional instances of {Line ID, Call ID, Grant Timestamp} field tuples |
| Pad | | Any value octet |
| FCS | 4 octets | Frame Check Sequence |

Fig. 78

| PIN NAME | CM-side Function (HPNA timing master) | | Handset Function (HPNA timing slave) | |
|--------------|--|----|---|-----|
| DPLL_REF_CLK | DPLL input clock | IN | | |
| Grant[4] | Grant Present Indication | IN | | |
| Grant[3] | Grant SID Value[3] | IN | | |
| Grant[2] | Grant SID Value[2] | IN | | |
| Grant[1] | Grant SID Value[1] | IN | | |
| Grant[0] | Grant SID Value[0] | IN | | |
| V_CLK_OUT | | | DPLL output clock | OUT |
| GPI[0] | | | Grant Present Indication[0] | OUT |
| GPI[1] | | | Grant Present Indication[1] | OUT |

Fig. 79

| PIN NAME | CM-side Function (HPNA timing master) | | Handset Function (HPNA timing slave) | |
|--------------|---|----|---|-----|
| DPLL_REF_CLK | DPLL input clock | IN | | |
| Grant[4] | Grant Present Indication | IN | | |
| Grant[3] | Grant SID Value[3] | IN | | |
| Grant[2] | Grant SID Value[2] | IN | | |
| Grant[1] | Grant SID Value[1] | IN | | |
| Grant[0] | Grant SID Value[0] | IN | | |
| V_CLK_OUT | | | DPLL output clock | OUT |
| Frame[0] | | | Frame boundary marker[0] | OUT |
| Frame[1] | | | Frame boundary marker[1] | OUT |

FIG. 80

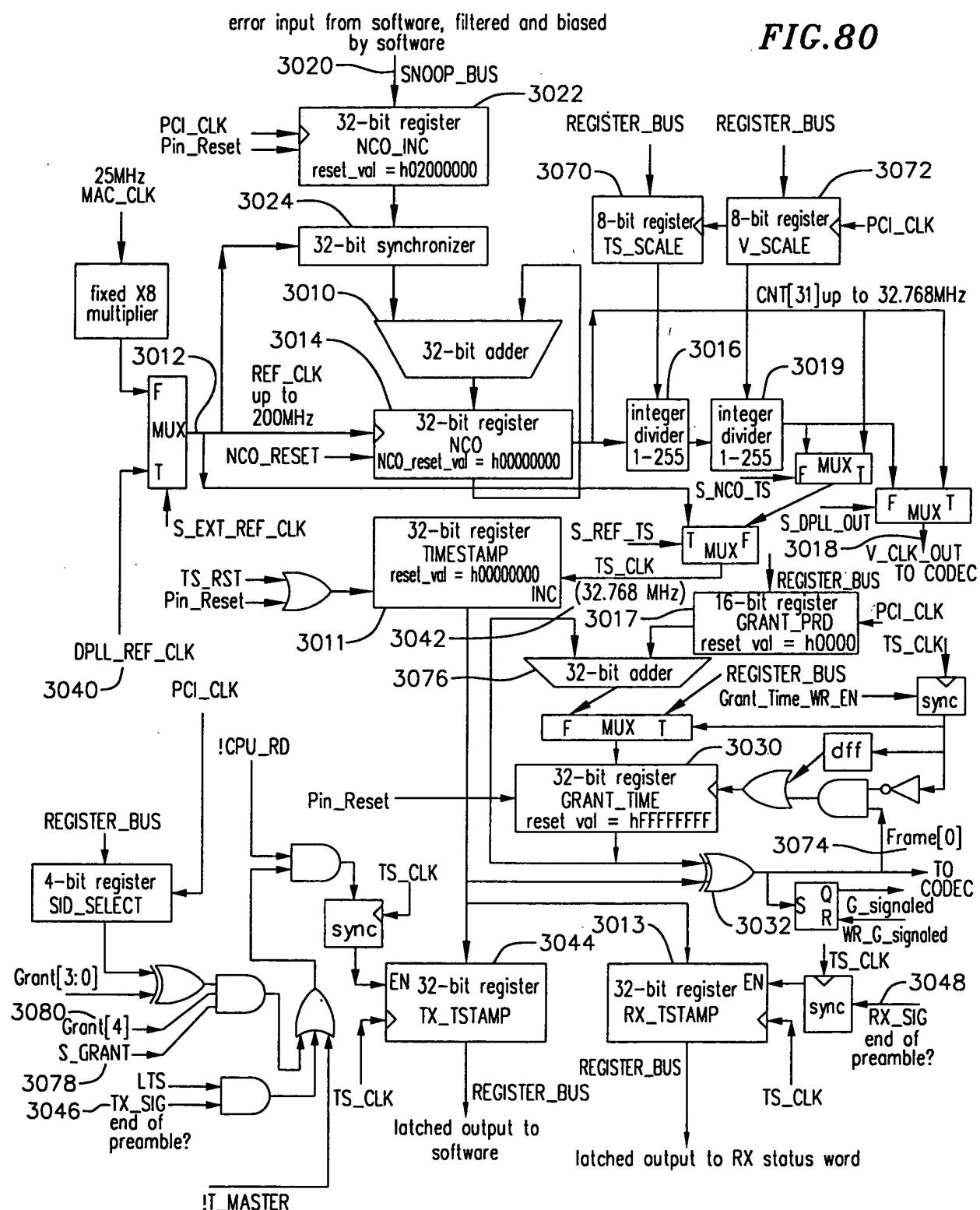


FIG. 81

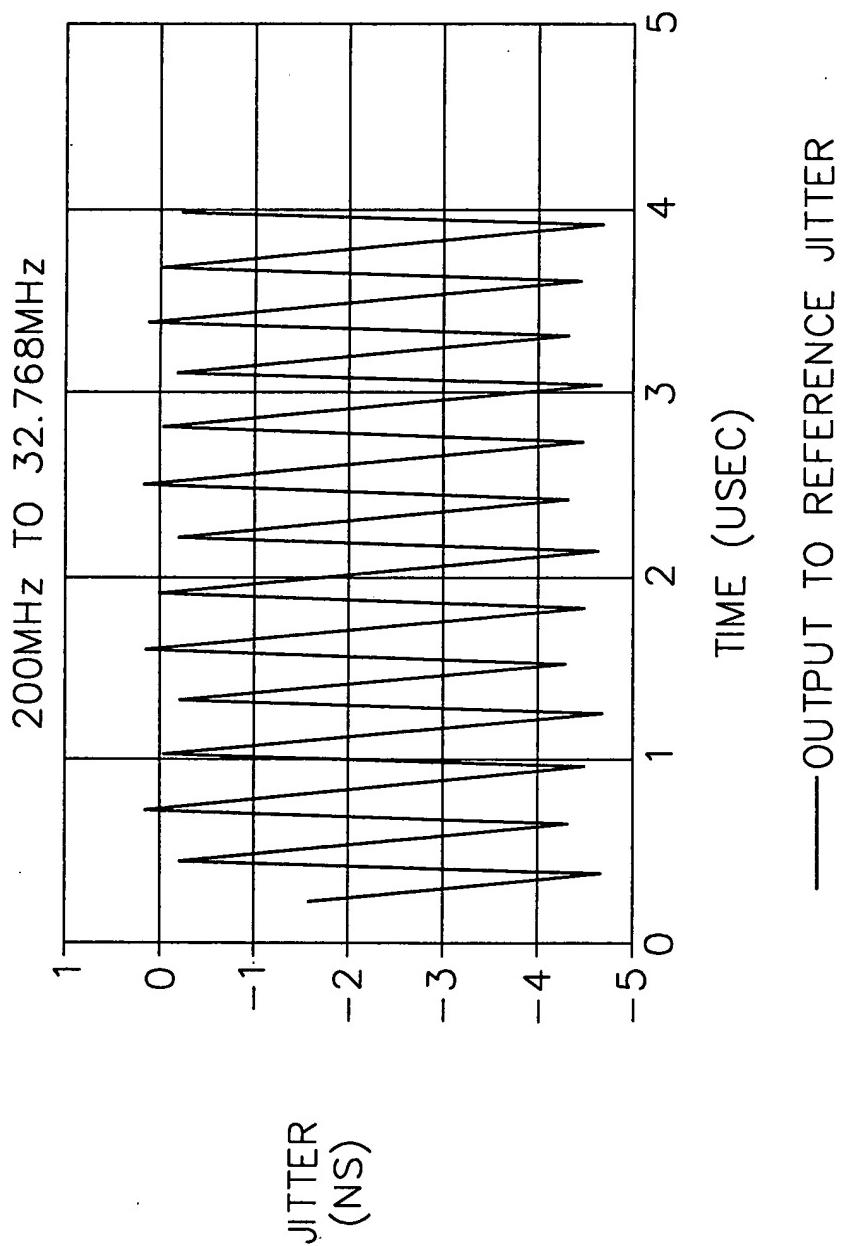


FIG. 82

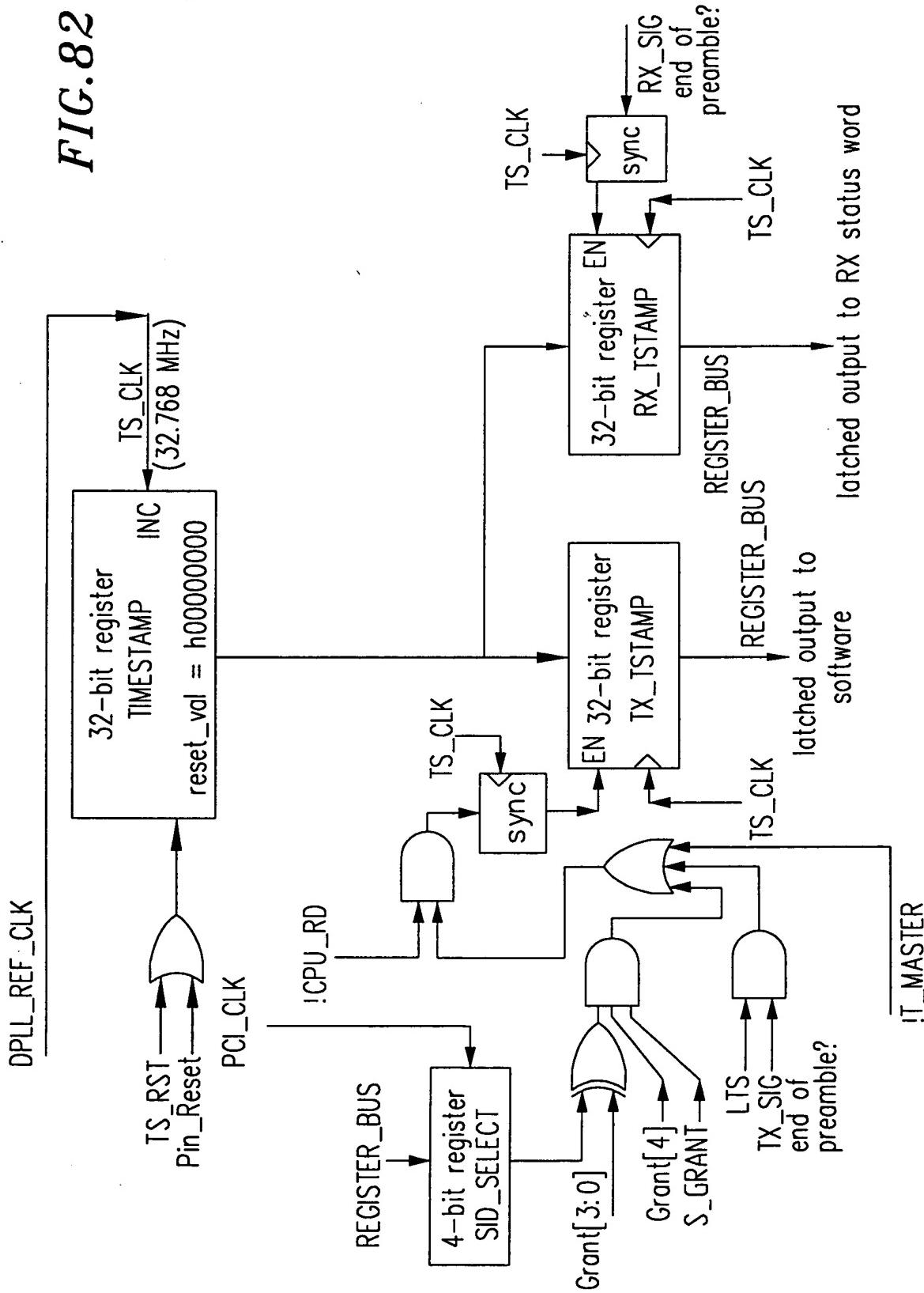


Fig. 83a

| PIN NAME | CM-side Function (HPNA timing master) | | Handset Function (HPNA timing slave) | |
|--------------|---|----|---|--|
| DPLL_REF_CLK | Timestamp input clock | IN | Timestamp input clock | |
| Grant[4] | Grant Present Indication | IN | NA | |
| Grant[3] | Grant SID Value[3] | IN | NA | |
| Grant[2] | Grant SID Value[2] | IN | NA | |
| Grant[1] | Grant SID Value[1] | IN | NA | |
| Grant[0] | Grant SID Value[0] | IN | NA | |

Fig.83b

| Bit locations | Field name | Description |
|---------------|------------|--|
| 7-3 | Reserved | |
| 2 | TsReset | When set to 1, forces timestamp register to value of 0x00000000. When set to 0, allows timestamp register to increment by one for each detected DPLL_REF_CLK rising edge. |
| 1 | SGrant | When set to 1, causes timestamp to be latched into txTimeStampHigh and txTimeStampLow registers whenever the value of tscSID matches the value of input pins Grant[3:0] and Grant[4] is asserted. When set to 0, disables txTimeStampHigh and txTimeStampLow latching under the stated conditions. |
| 0 | TMaster | When set to 1, enables txTimestampHigh and txTimestampLow registers to be latched with timestamp values at times determined by frame transmissions (through the LTS descriptor bit) or grant events (through the sGrant descriptor bit). When set to 0, enables txTimestampHigh and txTimestampLow registers to be latched with timestamp values at times determined by txTimeStampHigh and txTimeStampLow register read accesses. |

Default value of this register is 0x05

| Bit locations | Field name | Description |
|---------------|------------|--|
| 7-4 | Reserved | |
| 3-0 | SID | SID value that is to be matched by Grant[3:0] pins in order to cause a grant timestamp value to be latched. When the Grant[3:0] pins match the SID value and the Grant[4] input is 1 and the sGrant register bit is 1, then the current timestamp value will be latched into the txTimeStampHigh and txTimeStampLow registers. |

Default value of this register is 0x00

Fig.83c

Fig. 83d

| Bit locations | Field name | Description |
|---------------|----------------|---|
| 15-0 | txTimeStampLow | Least significant 16 bits of the latched tx timestamp value |

Default value of this register is undefined.

Fig. 83e

| Bit locations | Field name | Description |
|---------------|-----------------|--|
| 15-0 | txTimeStampHigh | Most significant 16 bits of the latched tx timestamp value |

Default value of this register is undefined.

Fig. 83f

| Bit locations | Field name | Description |
|---------------|----------------|---|
| 15-0 | rxTimeStampLow | Least significant 16 bits of the latched rx timestamp value |

Default value of this register is undefined.

Fig. 83g

| Bit locations | Field name | Description |
|---------------|-----------------|--|
| 15-0 | rxTimeStampHigh | Most significant 16 bits of the latched rx timestamp value |

Default value of this register is undefined.

FIG. 84a

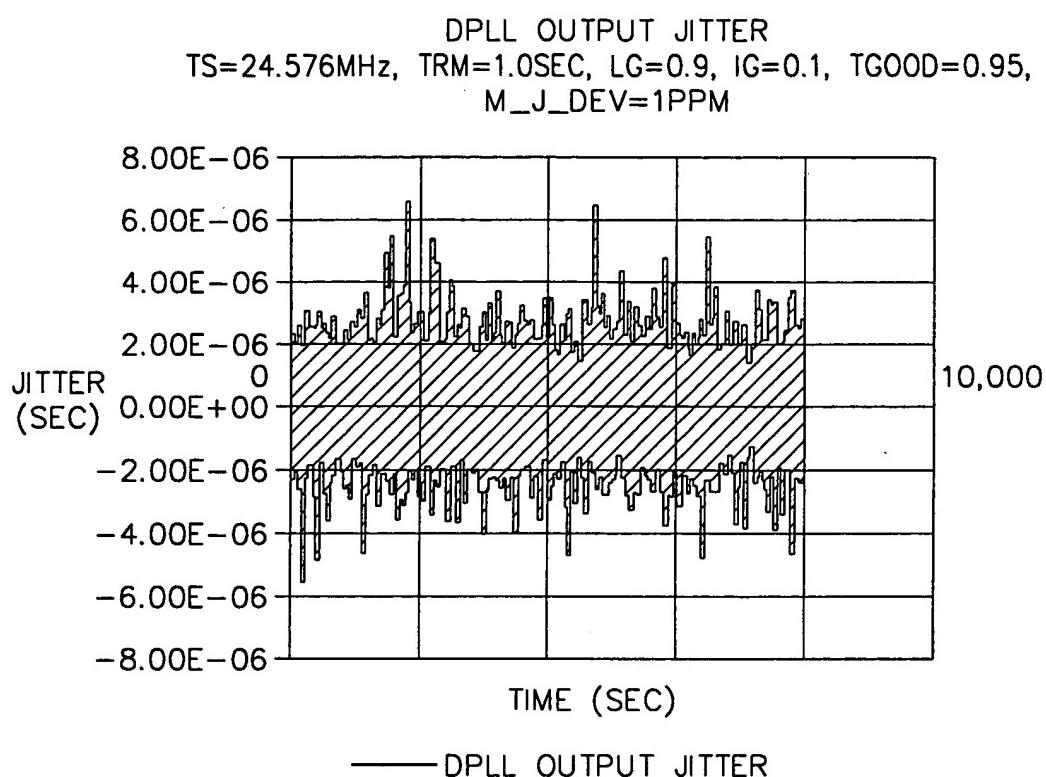


FIG. 84b

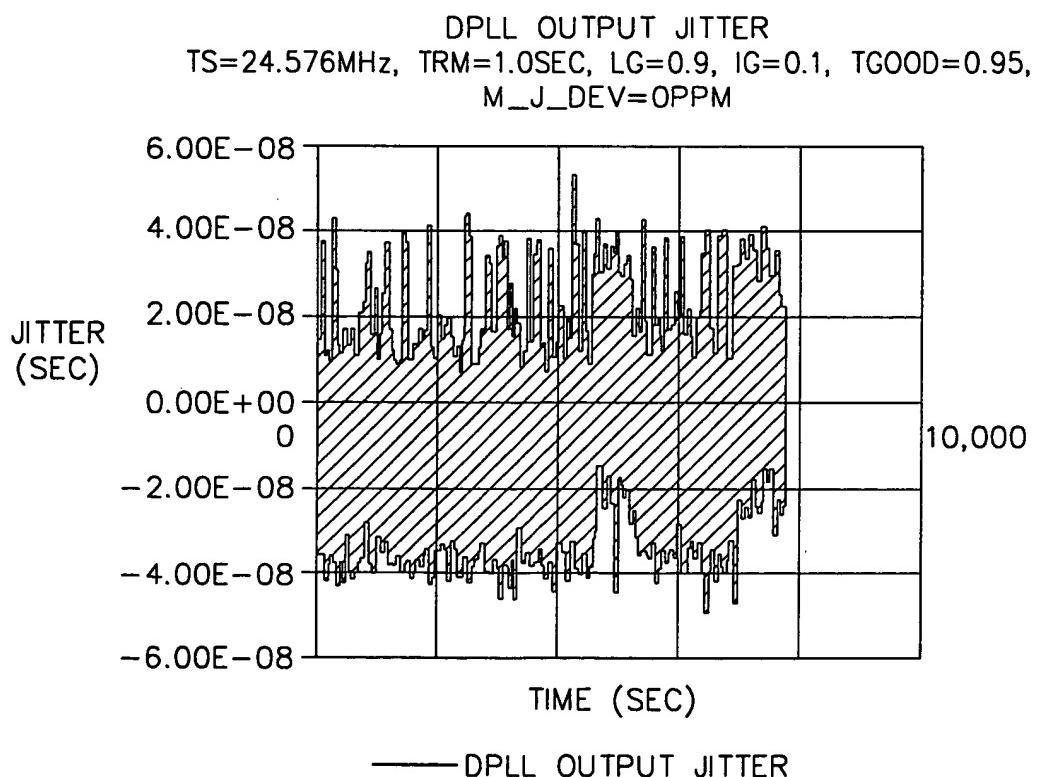


Fig. 85(1)

| <u>Field</u> | <u>Length</u> | <u>Meaning</u> |
|---------------|---------------|---|
| DA | 6 octets | Destination Address (FF.FF.FF.FF.FF.FF) |
| SA | 6 octets | Source Address |
| Ethertype | 2 octets | 0x886c (HPNA Link Control Frame) |
| SSType | 1 octet | = TBD |
| SSLength | 1 octet | Number of additional octets in the control header, starting with the SSVersion field and ending with the second (last) octet of the Next EtherType field. Minimum is 16. |
| SSVersion | 1 octet | = 0 |
| TRM_type | 1 octet | Value of x00 means that this is a TRM containing a valid timestamp. Value of x01 means that the master does not have a valid clock and slaves should give local indication that they are no longer locked to a master reference. Value of x80 means that this is a TQM. Value of x81 means that this is a TSM. All other values are reserved. |
| TRMSeqNum | 2 octets | Timestamp Report Message Sequence Number for this message. Sequence number of x0000 indicates an initial TRM, implying that Timestamp and PrevTRMSeqNum are both invalid. |
| PrevTRMSeqNum | 2 octets | Sequence number of TRM to which the Timestamp in this message is applicable. The value of PrevTRMSeqNum is not necessarily equal to TRMSeqNum minus one. PrevTRMSeqNum is set to x0000 for the first TRM of a TRM pair. |

Fig. 85(2)

| <u>Field</u> | <u>Length</u> | <u>Meaning</u> |
|--------------|---------------|---|
| Timestamp | 4 octets | Timestamp of a previously transmitted Timestamp Report Message, corresponding to PrevTRMSeqNum. The LSBit of the Timestamp corresponds to a time of 0.030517578125μsec = one clock tick at 32.768MHz. The Timestamp will rollover every 131 seconds = 2.2 minutes. |
| NumSlots | 1 octet | Number of Slot Timestamps specified in the payload of this control message. NumSlots may be zero. Each Slot Timestamp is accompanied by a MACAddr, and Channel_ID field. Including the Slot Timestamp, each Slot Timestamp is 12 bytes long. |
| PAD_0 | 3 octets | Padding to align to a 32-bit boundary. Always present, even when NumSlots has the value of 0. |
| MACAddr | 6 octets | MAC Address associated with the immediately following Channel_ID and STimestamp. |
| Channel_ID | 2 octets | Identifier for a channel associated with the immediately preceding MACAddr. |
| STimestamp | 4 octets | Slot Timestamp corresponding to the immediately preceding Channel_ID. This is the time at which the TRM sender wishes to receive a future constant bit rate service flow packet in order to minimize overall latency of delivery to a synchronous network. The time value corresponds to the time at the timing master. Additional packets for the identified service flow are expected to arrive at periodic intervals measured from this time. The LSBit of the STimestamp corresponds to a time of 0.030517578125μsec = one clock tick at 32.768MHz. |
| MACAddr | 6 octets | MAC Address associated with the immediately following Channel-ID and STimestamp. |
| Channel_ID | 2 octets | Identifier for a channel associated with the immediately following Channel_ID and STimestamp. |

Fig. 85(3)

| <u>Field</u> | <u>Length</u> | <u>Meaning</u> |
|----------------|------------------------------|--|
| STimestamp | 4 octets | Slot Timestamp corresponding to the immediately preceding Channel_ID. This is the time at which the TRM sender wishes to receive a future constant bit rate service flow packet in order to minimize overall latency of delivery to a synchronous network. Additional packets for the identified service flow are expected to arrive at periodic intervals measured from this time. The LSB of the STimestamp corresponds to a time of $0.030517578125\mu\text{sec}$ = one clock tick at 32.768 MHz. |
| ... | | [additional instances of MACAddr, Channel_ID and Gtimestamp fields, until the number of Gtimestamp fields equals NumGrants] |
| Next Ethertype | 2 octets | = 0 |
| Pad | max (0, 44-SSLengt h octets) | Any value octet |
| FCS | 4 octets | |

Fig. 86

| <u>Field</u> | <u>Length</u> | <u>Meaning</u> |
|----------------|-----------------------------|---|
| DA | 6 octets | Destination Address (FF.FF.FF.FF.FF.FF) |
| SA | 6 octets | Source Address |
| Ethertype | 2 octets | 0x886c (HPNA Link Control Frame) |
| SSType | 1 octet | = 6 |
| SSLength | 1 octet | Number of additional octets in the control header, starting with the SSVersion field and ending with the second (last) octet of the Next EtherType field. Minimum is 4. |
| SSVersion | 1 octet | = 0 |
| TRM_type | 1 octet | Value of x80 means that this is a TQM. |
| Next EtherType | 2 octets | = 0 |
| Pad | MIN(0, 4 - SSLength) octets | Any value octet |
| FCS | 4 octets | |

Fig. 87

| <u>Field</u> | <u>Length</u> | <u>Meaning</u> |
|----------------|--------------------------------------|---|
| DA | 6 octets | Destination Address (FF.FF.FF.FF.FF.FF) |
| SA | 6 octets | Source Address |
| Ethertype | 2 octets | 0x886c (HPNA Link Control Frame) |
| SSType | 1 octet | = 6 |
| SSLength | 1 octet | Number of additional octets in the control header, starting with the SSVersion field and ending with the second (last) octet of the Next EtherType field. Minimum is 4. |
| SSVersion | 1 octet | = 0 |
| TRM_type | 1 octet | Value of x81 means that this is a TSM. |
| Next EtherType | 2 octets | = 0 |
| Pad | MIN(0,4 0- SSLength) octets | Any value octet |
| FCS | 4 octets | |

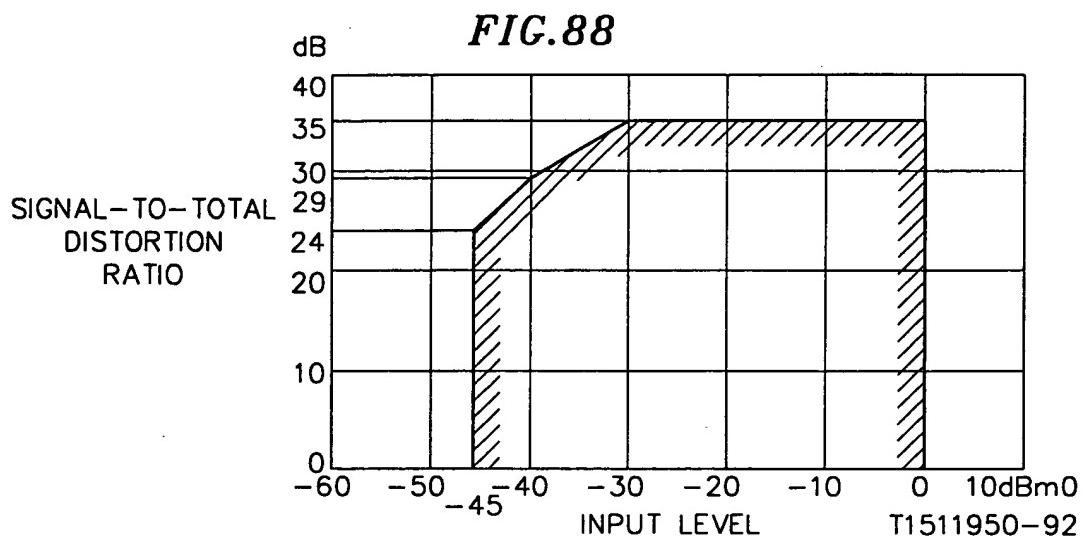


FIG.89a

| INPUT LEVEL | UNIFORM QUANTIZER + COMPANDER SNR | THE REQUIRED SNR FOR ADC/DAC |
|-------------|-----------------------------------|------------------------------|
| 0dBm | 38.43dB | 60dB |
| -30dBm | 35.50dB | 54dB |
| -40dBm | 30.09dB | 44dB |

FIG.89b

| INPUT LEVEL | G.712 SNR SPEC | THE TOTAL SNR WITH UNIFORM QUANTIZER+COMPANDER+JITTER CLOCK |
|-------------|----------------|---|
| 0dBm | 35dB | 38.32dB (60dB ADC/DAC SNR IS USED) |
| -30dBm | 35dB | 35.42dB (54dB ADC/DAC SNR IS USED) |
| -40dBm | 29dB | 30.05dB (44dB ADC/DAC SNR IS USED) |

FIG.89c

| INPUT LEVEL | G.712 SNR SPEC | THE TOTAL SNR WITH UNIFORM QUANTIZER+COMPANDER+JITTER CLOCK |
|-------------|----------------|---|
| 0dBm | 35dB | 38.38dB (60dB ADC/DAC SNR IS USED) |
| -30dBm | 35dB | 35.26dB (54dB ADC/DAC SNR IS USED) |
| -40dBm | 29dB | 30.03dB (44dB ADC/DAC SNR IS USED) |

FIG. 90

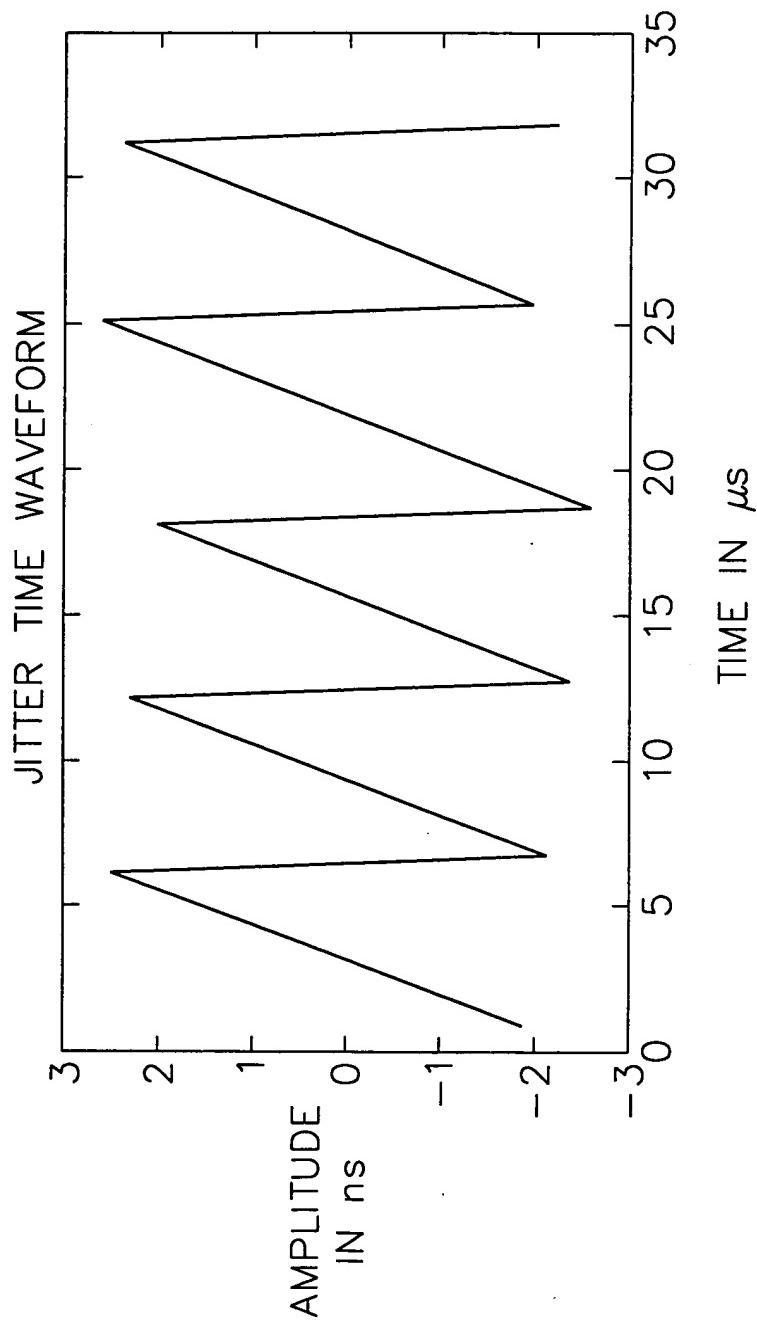


FIG. 91

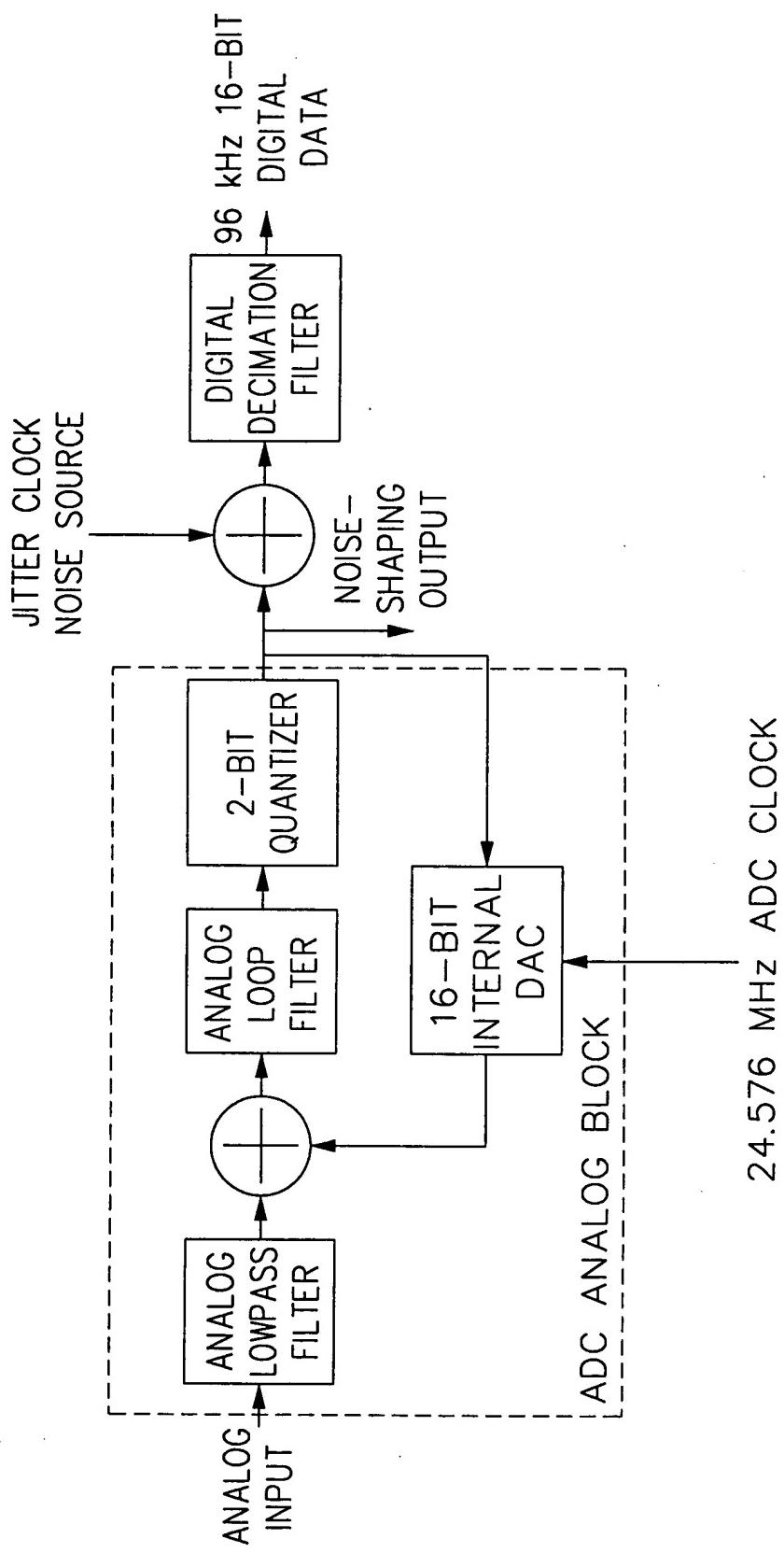


FIG. 92

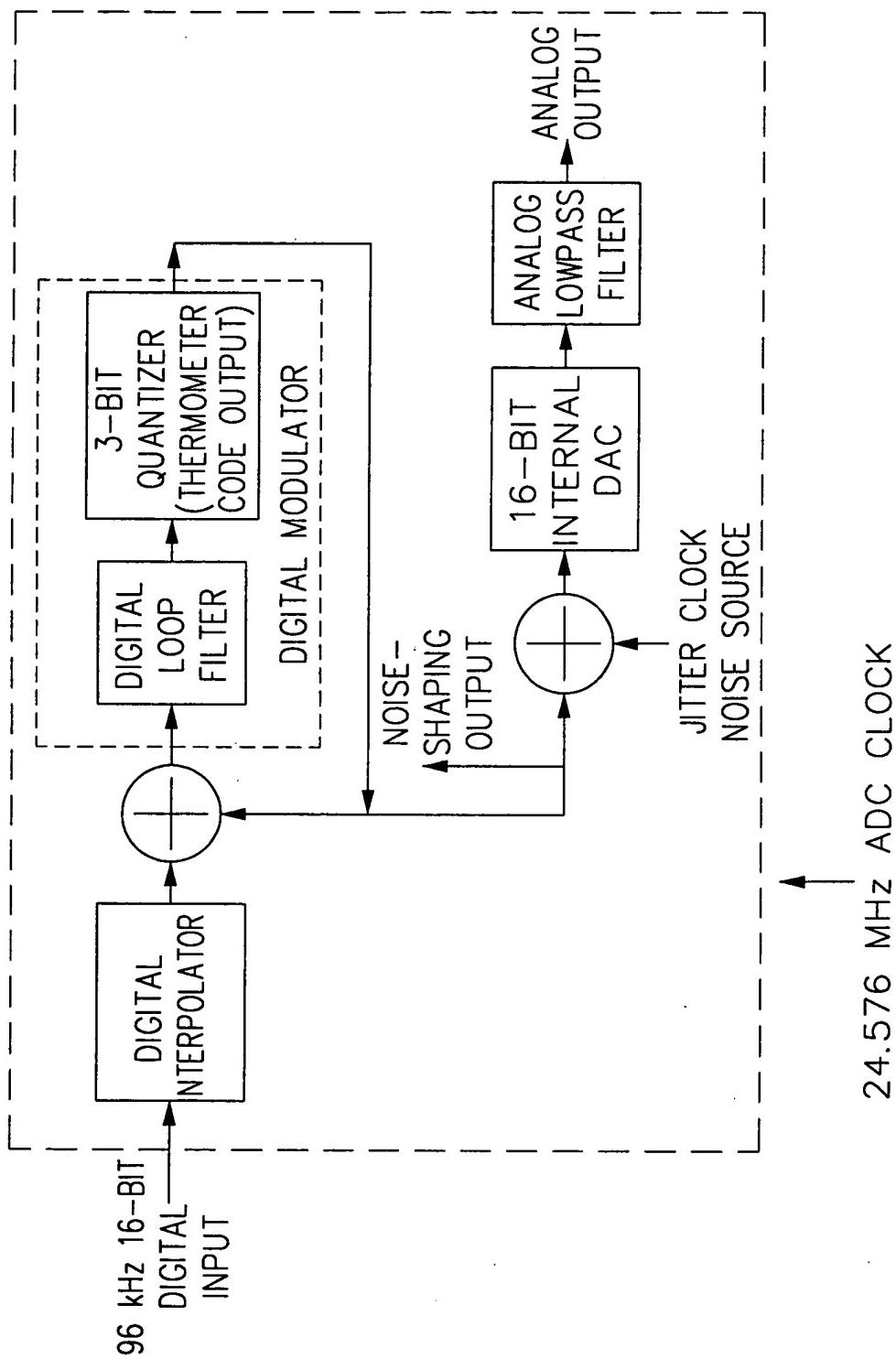


Fig. 93(1)

| Octet | Field | Length | Description |
|---------|-----------------------|--------|--|
| Flags 0 | TxPriority7 | 1 | Station is (was) transmitting frames with LL priority 7. (always set) |
| | TxPriority6 | 1 | Station is (was) transmitting frames with LL priority 6. |
| | TxPriority5 | 1 | Station is (was) transmitting frames with LL priority 5. |
| | TxPriority4 | 1 | Station is (was) transmitting frames with LL priority 4. |
| | TxPriority3 | 1 | Station is (was) transmitting frames with LL priority 3. |
| | TxPriority2 | 1 | Station is (was) transmitting frames with LL priority 2. |
| | TxPriority1 | 1 | Station is (was) transmitting frames with LL priority 1. |
| | TxPriority0 | 1 | Station is (was) transmitting frames with LL priority 0. (always set) |
| Flags 1 | Reserved | 5 | Shall be sent as 0 and ignored by 2.0 stations when received. |
| | CSS_Master_Capability | 1 | This station is capable of operating as a CSS Master node. |
| | No_V1M2_Frames | 1 | This station does not support the reception or transmission of compatibility frames (V1M2 frames). |
| | Supports 4Mbps | 1 | This station supports 4 megabaud payload encodings. |
| Flags 2 | Reserved | 8 | Shall be sent as 0 and ignored by 2.0 stations when received. |
| Flags 3 | ConfigV2 | 1 | Force use of 10M8 mode, defers to Config1 and ConfigV1Ms. |
| | ConfigV1M2 | 1 | Force use of HPNA V1M2 mixed mode, defers to ConfigV1. |

Fig.93(2)

| Octet | Field | Length | Description |
|-------|-----------------|--------|--|
| | ConfigV1 | 1 | Force use of HPNA 1.x mode, highest precedence of config flags. |
| | Reserved | 2 | Shall be sent as 0 and ignored by 2.0 stations when received. |
| | Highest Version | 3 | This station's highest supported HPNA version: 0x000 -- Reserved 0x001 -- HPNA 1.0 0x010 -- HPNA 2.0 0x001-0x111 Reserved |

Fig. 94

| <u>Field</u> | <u>Length</u> <u>h</u> | <u>Meaning</u> |
|--------------|---------------------------|---|
| CSEType | 1 octet | X00 = signifies a CSS Extension type |
| CSELength | 1 octet | X08 = Number of additional octets in this CSEType. CSELength is always x08 for CSEType = x00 = CSS |
| CSS_MAC | 6 octets | MAC address of client station |
| CSS_SEQ | 2 octets | CSS sequence, 8 two-bit values concatenated: 0-2 indicate a specific signaling slot, while 3 indicates the use of a randomly selected value chosen by the client at the time of the collision. X0000 - xBFFF = assigned CSS_SEQ value for the node possessing the MAC address specified in CSS_MAC XC000 - xFEFF = reserved XF00 = indication by the client node specified by CSS_MAC that it is no longer an active sender of link layer priority 6 frames (equivalent to a "0 active channels" indication) XF01 - xFFFE = request by the client node specified by CSS_MAC for a CSS Sequence from the master node. The 8 Least significant bits indicate the number of active channels which are sending link layer priority 6 frames for this client. XFFF - reserved |

Fig. 95

| 2-bit CSS register value (binary) | Signal slot integer (decimal) |
|--------------------------------------|-------------------------------|
| 00 | 0 |
| 01 | 1 |
| 10 | 2 |
| 11 | Random in range [0,2] |

| Bit Number | Value |
|------------|---|
| 7:0 | <p>Station Type:</p> <p>0 – HomePNA 1.x station</p> <p>1 – 10M8 station in V1M2 Mode</p> <p>2 – 10M8 station in V1M2 Mode, that has detected a recent 1M8 transmission with PCOM Station Type = 0</p> <p>Other values reserved</p> |
| 31:8 | Reserved, must be 0 on transmission |

Fig. 96

| Precedence | Variable |
|------------|--------------|
| 1 | ConfigV1 |
| 2 | ConfigV1M2 |
| 3 | ConfigV2 |
| 4 | V1_DETECTED |
| 4 | V1_SIGNALLED |

Fig. 97

FIG. 98

